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# CARCINOMA OF THE TONGUE

## A REVIEW OF FOURTEEN CASES

FRANK R. SPENCER, M.D.

BOULDER, COLO.

Carcinoma of the tongue is not frequently seen, even in rather large hospitals, but when it is seen for the first time in the hospital the diagnosis is often so evident and the disease so far advanced that it is too late for surgical intervention, provided such treatment may have been indicated early. In the incipient or early stage often the physician does not recognize the seriousness of the disease or the patient is too indifferent to heed the warning. The latter is especially true of patients in a charity hospital. Most otolaryngologists have been able to diagnose cancer much earlier in private patients than in those dependent on charity.

Gordon [1] stated:

> Cancer of the tongue claims the special interest of surgeons for several reasons. It, not infrequently, causes more suffering than any other form of cancer, and, in men, is said to kill in about eighteen months from the time it is first seen. In women the duration of life is somewhat longer. Treatment is highly unsatisfactory.

However, one must be careful not to frighten the patient in an effort to practice preventive medicine, because some persons suffer from cancerophobia. This applies particularly to the tongue and especially to geographic tongue. The tongue changes in appearance frequently. The deep fissures often worry a highly nervous person when he views his tongue in a mirror. Mature judgment based on a broad clinical experience will help the surgeon to judge the type of patient with whom he is dealing.

Judd and New [2] said:

> In spite of the fact that cancer of the tongue, because of its location, is detected in the early stages, the results of treatment have not been satisfactory, chiefly because physicians and dentists have not appreciated the importance of the treat-

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Presented at the annual meeting of the American Laryngological, Rhinological and Otological Society, Denver, May 20, 1936.

From the Departments of Otolaryngology and Pathology, University of Colorado School of Medicine and Hospitals, Denver.

1. Gordon, T. E.: Cancer of the Tongue, Irish J. M. Sc., June 1927, p. 250.

2. Judd, E. Starr, and New, Gordon B.: Carcinoma of the Tongue, Surg., Gynec. & Obst. **36**:163 (Feb.) 1923.

ment of the precancerous conditions, and of diagnosing and treating early malignancy.

According to Schmidt:[3]

> Cancer of the tongue is rare in a clean mouth. Oral sepsis, itself, has been held as a cause of cancer, and certainly, if it is not the cause, it is a complicating factor. Decayed, irregular and jagged teeth and poorly fitting dentures can be traced as the initiating cause of many cases. Acute injury is seldom a cause, but chronic irritation, resulting in ulceration, is frequently found to be one.

Beck and Guttman[4] stated:

> The otolaryngologist is usually looked to for advice regarding carcinoma of the oral cavity and we, as otolaryngologists, should be prepared to render valuable aid in diagnosis and treatment.

Recent advances in the knowledge of histopathology, a better classification of different degrees of malignancy by Broders,[5] surgical excision, surgical diathermy, cauterization and irradiation have led to a better understanding of malignant disease and to more early cure, or at least to arrest of the disease, because there are few cures.

In a series of 14 cases at the Colorado General Hospital, from the time it was opened as a new hospital, in September 1924, to September 1935, inclusive, all the patients were admitted for diagnosis and treatment in a late stage of the disease. There are no private patients included in the series.

## ANALYSIS OF CASES

*Sex.*—A review of this series of cases shows that 13 patients were men and 1 was a woman. The disease is much more frequent in men. In New's[6] series, 84.2 per cent of the patients were men. Judd and New[2] expressed the belief that "in about nine of ten instances, cancer of the tongue occurs in men." Schreiner and Brown[7] found 106 cases of lingual carcinoma in men and 21 in women in their series of 127 cases from 1913 to 1925 at the New York State Institute for the Study of Malignant Disease. Of their cases of malignant growth in any part of the body, in 3 per cent the condition involved the tongue only.

3. Schmidt, W. H.: Cancer of the Tongue, Arch. Phys. Therapy **15**:346 (June) 1934.

4. Beck, Joseph C., and Guttman, M. Reese: Carcinoma of the Tongue with Special Reference to Treatment by Irradiation, Ann. Otol., Rhin. & Laryng. **41**: 924, 1932.

5. Broders, A. C.: Squamous Cell Epithelioma of the Lip, J. A. M. A. **74**: 656 (March 6) 1920.

6. New, Gordon B.; Broders, Albert C., and Childrey, John H.: Highly Malignant Tumors of the Pharynx and Base of the Tongue, Surg., Gynec. & Obst. **54**:164 (Feb.) 1932.

7. Schreiner, Bernard F., and Brown, Harold F. R.: An Investigation of the Results Obtained in Cancer of the Tongue Treated by Radium and Roentgen Rays, Am. J. Roentgenol. **15**:207 (March) 1926.

*Age.*—The ages of the patients in the series from the Colorado General Hospital ranged from 42 to 80, the ages being 42, 51, 52, 58, 64, 64, 64, 69, 70, 72, 72, 72, 76 and 80. The average age was 64 +.

*Nationality.*—There were 1 Mexican and 1 Czechoslovakian in the group, and the remaining 12 were Americans. Race seems to be of little importance in the occurrence of carcinoma of the tongue, although it may play an important part in the occurrence of cancer of other organs, such as the skin and esophagus.

*Occupation.*—The group of patients consisted of 3 farmers, 3 clerks, 1 bartender, 1 newspaper reporter, 1 miner, 1 housewife, 1 laborer, 1 plumber, 1 ranchman and 1 printer. There is no evidence that occupation was a cause of the cancer in a single case, either directly or indirectly, with the possible exception of the bartender.

*Wassermann Reaction.*—All the patients, except the woman, were given at least one Wassermann test, and the reactions were negative. Only 1 patient was known to be syphilitic and his Wassermann reaction was negative because he had been treated actively for several months before admission to the hospital. He did not have a history of glossitis prior to the development of carcinoma. According to Craver:[8]

> Syphilis probably does not foster the development of cancer in any general sense but only in certain locations, such as the tongue, where syphilitic glossitis and leukoplakia may form the basis for multiple carcinomas.

New[9] stated:

> Syphilitic disease of the mouth may be seen as thickened leukoplakia of the tongue with areas of hyperplasia. We at the Clinic feel that such lesions are potentially malignant and should be removed with diathermy, the entire area involved being wiped off with the diathermy point. Twenty to twenty-five per cent of malignant diseases of the tongue are secondary to syphilitic lesions, and at times one sees the change from leukoplakia to thickened leukoplakia, the cracked and fissured area, the area of hyperplasia, and then one point that is definitely malignant.
>
> The presence of multiple lesions of the tongue does not mean that they are not malignant, as I have seen a patient with three distinct epitheliomas of the tongue associated with syphilis, each one a separate lesion. Thickened leukoplakia about the mouth, regardless of their etiology, are potentially malignant and should be widely removed with the cautery. If, microscopically, early malignant change is found, removal of the lymph nodes of the neck is advisable.

Keith[10] stated:

> Many authors think cancer of the oral cavity is more frequently found in patients suffering from luetic infection. For this reason, all patients with sus-

8. Craver, Lloyd F.: Etiology of Cancer: A Partial Review, J. A. M. A. **105**:1820 (Dec. 7) 1935.

9. New, Gordon B.: The Recognition of Certain Lesions of the Mouth, Proc. Staff Meet., Mayo Clin. **11**:76 (Jan. 29) 1936.

10. Keith, D. Y.: Carcinoma of the Tongue, Radiol. Rev. & Chicago M. Rec. **54**:56 (March) 1932.

picious luetic lesions, ulcers, or frank malignancies of the tongue should have a blood Wassermann test before treatment for malignancy is instituted.

A test of the blood was made in all but 1 of the 14 cases, and a test of the spinal fluid in some of them was also made, before any treatment was undertaken. Syphilis may have been a cause of cancer in 1 case, but it certainly was not the cause in the others.

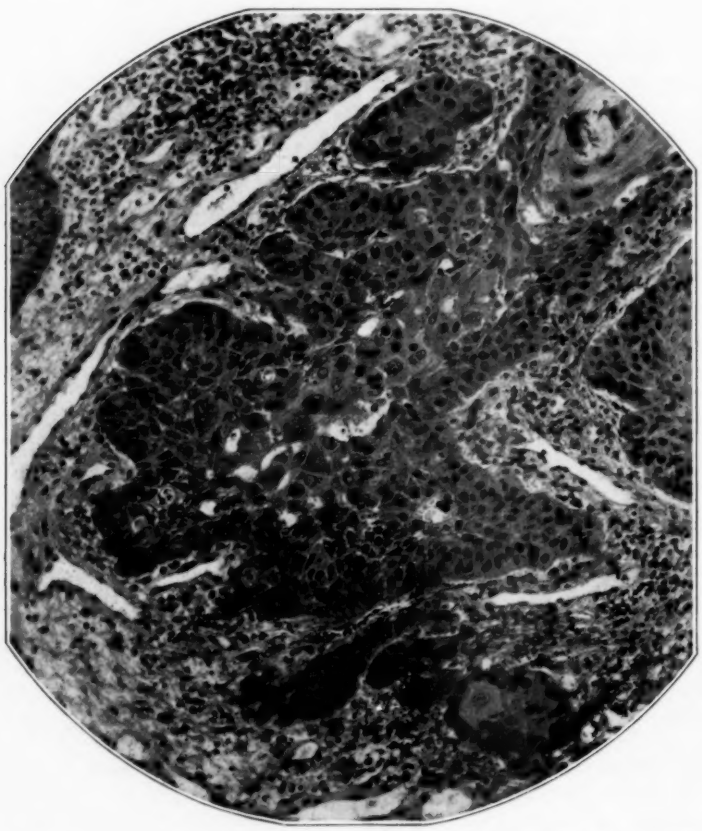

Fig. 1.—Photomicrograph of a biopsy specimen of squamous cell carcinoma of the tongue.

*Biopsy.*—Biopsy was not performed in 10 cases, first, because the diagnosis was evident and, second, because the removal of a specimen often makes the disease more active, with rapid metastasis. One biopsy was not satisfactory, according to the pathologist, because too little tissue was removed for histopathologic study. The other 3 biopsy specimens all showed squamous cell carcinoma, which is the usual type of lingual carcinoma. The cylindric cell tumor is the exception.

Dougherty [11] reported a case of what he believed clinically to be epithelioma of the tongue, but as the growth was seen at an early stage and no biopsy was made the diagnosis cannot be accepted without question. Most of the diagnoses of lingual carcinoma are made without a biopsy, however, and with relatively few errors, just as the late and highly esteemed J. E. Mackenty diagnosed carcinoma of the larynx without a biopsy.

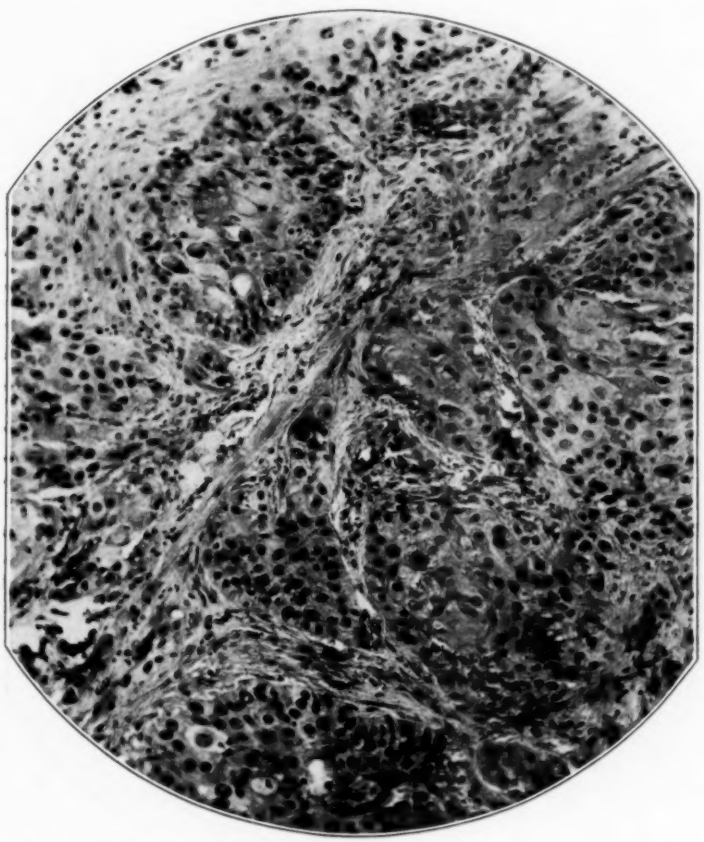

Fig. 2.—Photomicrograph of a biopsy specimen of squamous cell carcinoma of the tongue.

New, Broders and Childrey [6] found grade 3 and 4 squamous cell carcinoma of the tongue more rapidly malignant than the lower grades, just as one would expect. Hence the advantage of Broders' [5] method of grading malignant tumors. Their treated patients lived much longer than those who were not treated, as one would also expect, and, as

11. Dougherty, D. S.: Epithelioma of the Tongue, Laryngoscope **21**:812, 1911.

shown by their tables, with treatment pain and suffering are greatly relieved and life is prolonged.

According to these authors:

It is not known why metastatic growths are not always of the same cell type as the primary lesion. It is, indeed, strange that, on metastasizing, a mixed lymphoid and epithelial cell type of neoplasm should lose one of its types of cell. It appears to us that the lymphocytes noted in the primary neoplasm are not a growing part of the tumor but are found there only because such cells are abundant in the mucous membrane of the pharynx and nasopharynx.

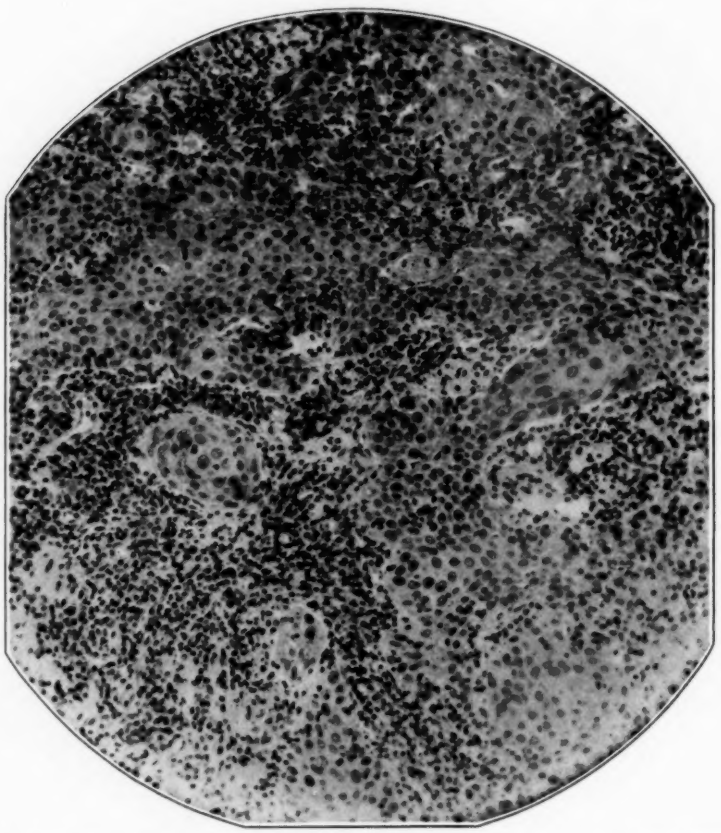

Fig. 3.—Photomicrograph of a biopsy specimen of squamous cell carcinoma of the tongue.

Ewing [12] stated that lympho-epithelioma is in reality a transitional cell carcinoma (also described by Quick and Cutler [13]). He stated,

12. Ewing, James: Some Phases of Intraoral Tumors with Special Reference to Treatment by Radiation, Radiology **9**:359, 1927.

13. Quick, Douglas, and Cutler, Max: Transitional Cell Carcinoma: A Radiosensitive Intraoral Tumor, Brit. J. Radiol. **32**:425, 1927.

too, that the transitional cell carcinoma is the same tumor as that described by Crowe and Baylor [14] and by New;[15] these three authors called it squamous epithelioma. Ewing [16] said:

The transitional-cell carcinomata arise from stratified epithelium of which the cells are delicate, without spines, do not produce keratin, and show little capacity to hornify. This type of epithelium is found over the tonsil, vault of the pharynx, nasal passages, *base of the tongue* and the nasopharyngeal sinuses. It often covers deposits of lymphoid tissue and hence has sometimes been called lympho-epithelium. Very anaplastic and malignant tumors derived from adult squamous cells may exhibit the same clinical features. The structure of the growth shows sheets of large, pale, delicate cells with thin membranes, large nuclei and indefinite cell outline. They infiltrate the submucosa or lymphoid tissue in sheets or small groups or singly. In the nodes, the cells may reveal some traces of squamous characters or they may become less differentiated and the structure may resemble lympho-sarcoma.

Simpson and Dunlevy [17] expressed the belief that Broders' [5] method of grading squamous cell carcinoma is extremely valuable both from the standpoint of the cure of the primary lesion and from the standpoint of probable invasion of adjacent lymph nodes.

They stated:

In tumors with a pathologic grading of "one" or "two," where cells of the mature variety preponderate, the disease does not appear to have such a marked tendency to slip off into the adjacent lymph nodes.

In tumors graded "three" and "four" where the cells are largely embryonal in type, the tendency to slip away into the nodes is much more pronounced. These latter two groups, however, respond to the action of radium much more readily than the first two groups.

*Complications.*—One patient died from terminal pneumonia while in the hospital. Two had erysipelas. One contracted smallpox a few days after admission.

*Glandular Metastasis.*—There was glandular involvement of either the right or the left cervical region in 6 cases. Metastasis in the lungs did not occur in any case. According to New:[18]

This demonstrates very well the fact that a patient who has involvement of the lymph nodes has about a fourth the chance of getting well that one who does not have involvement of the lymph nodes has.

---

14. Crowe, S. J., and Baylor, J. W.: Benign and Malignant Growths of the Nasopharynx and Their Treatment with Radium, Arch. Surg. **6**:429 (March) 1923.

15. New, Gordon B.: Syndrome of Malignant Tumors of the Nasopharynx: A Report of Seventy-Nine Cases, J. A. M. A. **79**: (July 1) 1922.

16. Ewing, James: Neoplastic Diseases: A Treatise on Tumors, ed. 3, Philadelphia, W. B. Saunders Company, 1928, p. 875.

17. Simpson, Frank E., and Dunlevy, George R.: Radium Technic in Cancer of the Tongue, Radiol. Rev. & Chicago M. Rec. **54**:71 (March) 1932.

18. New, Gordon B.: Malignant Disease of the Mouth and Accessory Structures, Am. J. Surg. **30**:46, 1935.

Gordon [1] stated:

As a matter of experience—and this is not without general interest—when recurrence does occur, it is not usually in the floor of the mouth. This obviously suggests that in tongue cancer the spread to the glands occurs by embolism and not by direct permeation.

*Location of Tumor.*—One tumor involved the tip in the midline and the frenum. Seven involved the right side and 6 the left. According to Simpson and Dunlevy: [17]

The lateral margin of the tongue is perhaps the most common site of tongue cancer. We have, indeed, come to believe that when a lesion is primarily situated on the dorsum of the tongue it speaks for gumma as against carcinoma although only by biopsy is certainty of diagnosis assured.

Ten tongues in the series reported here were ulcerated, and 3 bled when palpated at the time of the patient's admission. Subsequent and more careful examinations showed that 5 were ulcerated, 3 had a nodule, 3 had warty growths, 2 had a fissure and 1 was excoriated.

According to Mead,[19] cancer of the tongue may begin as a blister, an excoriation, an ulcer, a fissure, a tiny tubercle, a wart or warty growth or a nodule in the substance of the tongue.

New [9] found that actinomycosis is quite comonm in his part of the country and stated:

Actinomysosis of the tongue may be present as a small nodule or cyst in the tongue or floor of the mouth or it may involve quite an extensive area. The presence of a small sulphur granule may be readily determined from the pus obtained and the diagnosis established.

Benign glossitis may be mistaken for a malignant condition when first examined. Subsequent observation usually excludes carcinoma. A number of such cases, in which the cause was actinomycosis, syphilis, cysts and trauma, were observed at the hospital.

Grier [20] stated:

Epithelioma inside the mouth differs from that of the face in the following particulars: (1) It grows rapidly and involves underlying structures early; (2) it metastasizes early; (3) it is more resistant to radiation, and (4) it is kept constantly moist by infected fluids, and light and air are excluded. These conditions promote infection and hinder the repair of the ulcer left after destruction of the lesion by irradiation. For the reasons just mentioned the treatment of carcinoma in the mouth is much more difficult and the prognosis much less favorable than is the case with similar lesions located on the skin surface. Added to these is the fact that the lesion is in a location where it is difficult to approximate

19. Mead, Sterling V.: Diseases of the Mouth, ed. 3, St. Louis, C. V. Mosby Company, 1928, p. 355.

20. Grier, G. W.: The Treatment of Intraoral Carcinoma by Contact Application of Radium, Am. J. Roentgenol. **15**:201 (March) 1926.

the radium accurately to the lesion and painful to keep it there. When all these drawbacks are considered it is small wonder that one finds little to boast of in the results obtained. The one consolation left to the radiologist is that no other form of treatment offers any better results. Surgery is seldom seriously considered in extensive intraoral malignancy.

Butlin and Spencer [21] observed 80 cases of cancer of the tongue, in which the dorsum was involved 15 times and the sides 56 times.

Four patients in this series were excessive smokers, and 1 chewed in moderation.

In Schreiner and Brown's [7] series of 127 cases the following data were found:

Ninety-six of the males gave a history of using tobacco in some form and one female smoked cigars and a pipe. The complaints of the patients on entrance were as follows: Sore tongue from canker sores, 62; sore tongue from irritation of sharp teeth, 31; sore throat, 15; swelling of tongue and difficulty in swallowing, 7; cracked tongue, 3; stinging and burning of tongue, 3; wart on tongue, 1; 4 patients gave a history of biting the tongue and one dated her present trouble from a sudden hemorrhage from the mouth.

Fig. 4.—Photograph of a carcinoma of the tongue.

*Treatment.*—Surgical removal of part of the tongue, except for removal of a biopsy specimen in 4 instances, was not resorted to in a single case, because radical surgical measures for carcinoma of the tongue has not been satisfactory according to the experience of most surgeons. Manson [22] reported complete relief after excision of the tongue, but cancer of the stomach developed thirty-four years later.

21. Butlin, H. T., and Spencer, H. G.: Diseases of the Tongue, London, Cassell & Co., Ltd., 1900, p. 310.

22. Manson, J. S.: Cancer of Tongue; Excision of Tongue; Cancer of Stomach Thirty-Four Years Later, Brit. M. J. **1**:996 (June 24) 1922.

According to Grier:[20]

In outlining a plan of treatment for any case of cancer of the mouth, two facts should be kept constantly in mind. The first is that metastasis to the lymph nodes is the most serious complication which can occur; and the second is that traumatism to the primary lesion may promote metastasis.

New, Broders and Childrey[6] stated:

It appears that considerable treatment by operation, diathermy, or cautery, is still being carried out for lesions which might be better treated by irradiation alone.

Quick[23] treated 473 patients with all types of carcinoma of the tongue, variously situated. Of these, 23, or 4.8 per cent, were free from disease for more than five years and some of them for as long as ten years.

Fig. 5.—Photograph of a carcinoma of the tongue.

*Irradiation.*—One patient received 80 mg. hours of radium, another 200, one 320 and a fourth 800. Several other patients received radium treatment either before admission or after being dismissed from the hospital. The exact amount of radium used and the number of hours it was applied could not be determined except while the patient was in the hospital. The amount of radium used was small.

According to New, Broders and Childrey:[6]

It is well known that certain highly malignant tumors of the base of the tongue are markedly radio sensitive, and that some of these, even in the presence of cervical metastasis, have disappeared completely under irradiation.

23. Quick, Douglas: Treatment of Intraoral Cancer with Special Reference to Radium Therapy, New York State J. Med. **30**:1094, 1930.

Simpson and Flesher,[24] commenting on irradiation, stated:

> In treating the lymph nodes of the neck we have usually relied on surface irradiation at a distance of 3 cm.; 7,000 mc.-hr. may be given to an area of 16 sq. cm. The average quantity of emanation that we have used for surface irradiation is 1,310 mc. . . .
>
> Radium emanation is of great value in intraoral cancer. For the best results at least from 500 to 1,000 or more millicuries must be available, and some experience with its effects is desirable. The use of small quantities of radium by the novice tends to discredit the method and to take away from the patient his chances of recovery.

Eleven of the patients at the Colorado General Hospital received varying amounts of low and of high voltage roentgen therapy either before admission or while in the hospital. Several received roentgen irradiation after leaving the hospital. The number of treatments given and the dosage used outside the hospital could not be determined.

One tumor was removed by electrocoagulation, and another was reduced in size by the use of carbon dioxide snow. Radium needles were used, as the hospital does not have a large amount of radium. Large hospitals with enough radium for a radium bomb, or teleoradium therapy, have an advantage in the treatment of malignant disease.

Beck and Guttman [4] recommended the use of the radium bomb, or teleoradium therapy. This means using from 1 to 4 Gm. of radium at a distance of 6, 10 or 15 cm. Only very large hospitals have this much radium. High voltage roentgen therapy often has to be used in most hospitals as a substitute. Beck and Guttman [4] "have elaborated a dictum that the biopsy determines the details of treatment." Simpson and Dunlevy,[17] before using their technic for the irradiation of lingual carcinoma, take into account the results of biopsy and Broders'[5] classification.

Schreiner and Brown [7] reported the following in regard to irradiation:

> More recently, the lymph-bearing areas have been treated with high voltage roentgen rays, a dose of 130 per cent being administered in the course of three or four sittings during a period of ten to twelve days, which promises more than any form of irradiation which we have applied to metastatic lesions from the tongue.

Surgical excision of the carcinoma by means of the radio knife followed by irradiation may sometimes be indicated in suitable cases when the growth is in an early stage. In 6 of the cases in the group reported here the growth involved the base of the tongue and adnexa, adding greatly to the difficulty of surgical removal. Early cancer of

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24. Simpson, Frank Edward, and Flesher, Roy Emmert: Radium Emanation in the Treatment of Cancer of the Tongue and Other Parts of the Oral Cavity, Am. J. Roentgenol. **15**:204 (March) 1926.

the tip of the tongue is more amenable to surgical removal. New, Broders and Childrey [6] treated 52.52 per cent of the malignant growths on the anterior two thirds of the tongue, but only 7.68 per cent of those involving the base and the hypopharynx.

Mackenzie's [25] method of extensive excision with the radio knife has been used with some success in a few cases. Trotter's [26] lateral pharyngotomy, as advocated by Orton,[27] may be used in other cases, especially for cancer about the base of the tongue and on one side of the hypopharynx.

Mezz [28] reported success in obtaining relief from pain caused by a squamous cell carcinoma of the tongue by the injection of alcohol into the third, or mandibular, division of the fifth nerve. The pain was so severe that it produced rapid loss of weight from inability to eat. After injection into the nerve at the mandibular foramen by the usual dental technic, roentgen and radium treatments were used. The relief from pain in cases of cancer of the tongue in an advanced stage presents a major problem. Any remedy which will lessen the necessity for large doses of narcotics is worth using.

## SUMMARY

The social service department of the hospital has not been able to trace 3 of the 14 patients. Of the 11 remaining, not 1 lived longer than the five year period that is so important after the removal of malignant

*Final Results in Fourteen Patients with Carcinoma of the Tongue*

| Case No. | Date of Admission | Date of Death |
|---|---|---|
| 1 | 4/18/26 | ? |
| 2 | 10/18/27 | 12/29/28 |
| 3 | 8/28/27 | 5/ 8/28 |
| 4 | 5/14/28 | ? |
| 5 | 7/12/28 | 8/15/33 |
| 6 | 1/12/29 | 6/ 3/29 |
| 7 | 12/11/29 | 4/30/33 |
| 8 | 12/ 2/29 | 1930 |
| 9 | 1/29/30 | 5/ 1/30 |
| 10 | 1/18/31 | ? |
| 11 | 4/20/31 | ? |
| 12 | 12/31/32 | 4/20/34 |
| 13 | 2/16/33 | 10/26/34 |
| 14 | 4/30/35 | 5/10/35 |

25. Mackenzie, Dan: The Treatment of Cancer of the Pharynx, Larynx and Esophagus by Surgical Diathermy, Ann. Otol., Rhin. & Laryng. **38**:32, 1929.

26. Trotter, Wilford: Principles and Technique of the Operative Treatment of Malignant Disease of the Mouth and Pharynx, Lancet **1**:1075 (April 19); 1147 (April 26) 1913.

27. Orton, H. B.: Lateral Transthyroid Pharyngotomy, Am. Laryng. A. **52**: 91, 1930.

28. Mezz, David: A Case of Carcinoma of the Tongue (Misreference of the Pain Following Alcohol Anesthesia): Report of a Case, Laryngoscope **42**:209, 1932.

tumors of all kinds. In fact, only a few lived two or three years. However, this was not unexpected, because all of the patients had advanced carcinoma when admitted to the hospital. The patient who survived the longest (patient 7) lived three years, four months and nineteen days.

## CONCLUSIONS

The literature on carcinoma of the tongue is voluminous; so it has been impossible to include in the bibliography many of the articles published even during the past ten years.

However, a review of the literature shows that definite progress is being made in the treatment. The disease is recognized earlier. Broders'[5] classification is a real help in outlining treatment. Surgical diathermy has been a definite improvement over cautery, although it has not, and should not, displace cautery entirely. Irradiation by high voltage roentgen rays is an improvement over low voltage irradiation, just as the radium bomb or teleoradium is an improvement over the use of small quantities of radium. The recognition of the importance of syphilis of the tongue in causing cancer and of carious teeth with poor dental hygiene will do much to prevent and relieve the suffering from lingual carcinoma.

Physician's Building.

# FIFTEEN YEARS' EXPERIENCE WITH DRAINAGE TUBES AFTER ANTROSTOMY IN CHILDREN

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In 1925 I [1] reported the results of five years' usage of rubber drainage tubes in children after antrostomy. The rubber tubes have been used since then with the following changes: More attention is being paid to the patency of the natural ostium; the number of days which the tubes are allowed to remain in place has been reduced from five or six to three or four days; the irrigating solution has been changed from a chemical antiseptic to normal physiologic solution of sodium chloride, or the inflation of air is used.

The conclusions presented in 1925 that have withstood the test of time are:

1. The end-results of antral drainage in children compare favorably with those obtained in adults.

2. Radical surgical operation on the antrum is rarely necessary in children.

3. Suppurative or allergic processes will arrest the development of the sinuses, but by reestablishment of their normal ventilation and drainage they are pneumatized and usually regain their lost growth.

4. The use of ordinary rubber catheters, no. 12, 14 or 16 French, the size depending on the age of the patient, have been found satisfactory. A well placed tube remains in place, permits free drainage and is easily and painlessly removed; the self-retaining type of tube sacrifices caliber and is difficult to remove, extraction often being very painful.

## SELECTION OF CASES

When to drain a child's antrum by surgical means is a difficult question. The attack on empyema of the antrum in a child should be thorough, but radical operation is seldom necessary. The local conditions and general manifestations must be carefully considered before drainage is advised. The most vital consideration is the removal of a focus of infection. The roentgenographic study includes consideration of the present pathologic and the morphologic picture of the sinuses, for a

1. Shea, J. J.: The End-Results of Sinus Surgery in Children, Arch. Otolaryng. **2**:111 (Aug.) 1925.

sinus which has been arrested in development lacks the ability to combat infection. Antrostomy is not intended as a treatment for acute sinusitis except when the general condition of the child demands immediate relief from the infection. Local treatment with rest in bed and, when possible, hospitalization are first tried. My routine is to give the child a mixture of aminopyrine and phenobarbital and ephedrine three or four times a day. I pack the nasal passages with cotton soaked in hypotonic salt solutions, expose the area to the infra-red rays for twenty minutes and then instil phenolated oil into the nasal passages. Immunity to infection is increased daily by the use of a nonspecific substance containing albumin, lipoid and fat or streptococcus antigen and by an

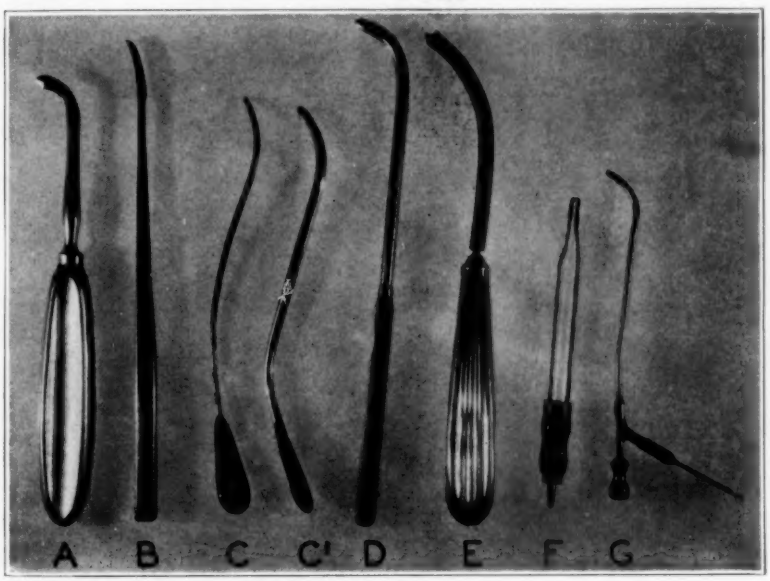


Fig. 1.—Instruments used in antrostomy: *A*, Arbuckle's antrum trocar knife and saw, modified by Shea; *B*, West's curved bone gouge; *C-C*$^{1}$, Ritter's frontal sinus bougie; *D*, Lillie's frontal sinus dilator; *E*, Alden's antrum drainage tube introducer; *F*, glass dropper used as a tester; *G*, Spielberg's frontal sinus dilator and irrigator.

occasional transfusion of blood. The use of suction, with or without displacement, is tried. Direct suction with a rubber catheter after the fashion extolled by William H. Haskin many years ago is of value in selected cases in which the condition is acute.

## OPERATIVE PROCEDURE

If the child's condition warrants, ether is the best anesthetic because the operative procedure can be deliberate and thorough. If renal infec-

tion is present either nitrous oxide or an ethylene mixture is safer than ether, though the operation must be done rapidly.

The nares are cleansed by suction, and the site of the operation is painted with a 30 per cent alcohol solution. The ostium of the antrum

Fig. 2.—Photograph showing tubes in the antrum.

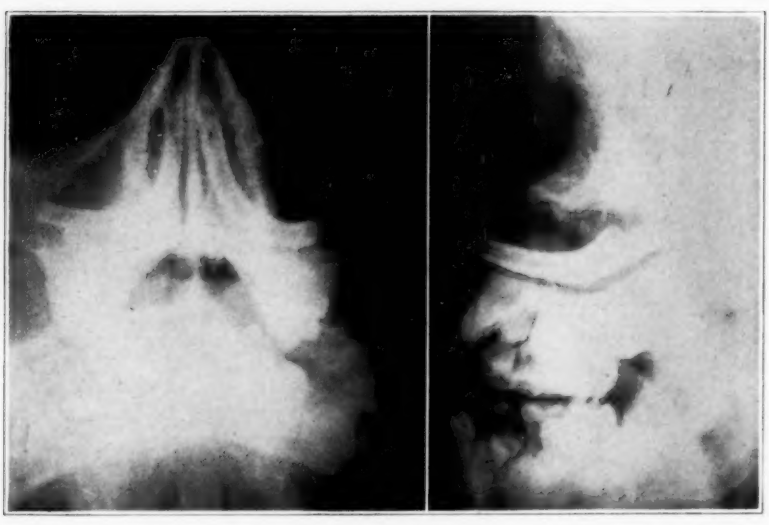

Fig. 3.—Roentgenogram showing the tubes in the antrum.

is sought and dilated. If it is not found, the membranous tissue of the middle meatus is perforated. The success of the operation depends on maintaining the patency of the ostium. Some of my earlier failures were the result of not appreciating the necessity of this second opening. A culture is made of material from the antrum. A straight trocar is

used and the material is obtained through a syringe and a needle. If the patient is suspected of being allergic, sterile physiologic solution of sodium chloride is used; otherwise brain broth medium is instilled and withdrawn. During the height of the phage craze, it was thought that leaving some of the medium within the antrum was of value, as the sinus could serve as an incubator for the growth of the phage, thus helping auto-immunization.

The naso-antral window is made with an antral trocar in the younger children and with a curved gouge in the older children. The aperature is then shaped to fit the rubber tube by a series of dilations with Ritter sounds. The catheter is then inserted, one of the smaller Ritter sounds being used as an obturator. There is a characteristic feel when the catheter slips through the window. Suction is then applied to the drain. The appliance used consists of a medicine dropper, through which the contents of the antrum are visualized. It is of value to note that air bubbles are freely mixed with the antral contents, for these bubbles denote the patency of the secondary opening. If no bubbles are visible, saline solution is forced through the tube until it appears in the back of the nose or the nasopharynx, thus blowing out any plug that might be blocking the ostium. Suction is again tried, and if no bubbles are visible through the glass the tube is removed and the steps of the operation are repeated, special attention being given to the ostium.

*Previous Removal of Tonsils and Adenoids.*—It is unusual if a child with sinusitis has not previously had the tonsils and adenoids removed. The postnasal discharge coming from the sinuses promotes the regrowth of the adenoids. Whenever parents bring their child to me with the statement that the child's adenoids have returned, I immediately search for sinusitis. The child with sinusitis who still has tonsils and adenoids demands additional study, for these have precedence over the sinuses as immunizers, and the presence of sinusitis practically presupposes that the tonsils and adenoids are diseased. Seldom do I leave the tonsils and adenoids in situ if I have to drain an antrum by the insertion of tubes.

*Postoperative Treatment.*—The postoperative care has been reduced to keeping the tubes open and instilling phenolated oil about the tubes. Acetylsalicylic acid is given at regular intervals according to the age of the patient, for it requires less medication to prevent a headache than to stop one. Many of the popular chemical antiseptics have been tried in irrigation of the antrum but have been discarded as of no particular value.

On the fourth morning the tubes are removed by instilling saline solution through them, which aids in their expulsion. So far the treatment has been painless. The child should not be afraid of the surgeon. The irrigations are continued until the discharge has ceased and are

reestablished any time drainage is impeded or if the opening has closed. The children are watched for a long time, and on the return of symptoms of sinusitis irrigation is again employed. In fact, it is advisable to irrigate the antrum at the end of any acute infection of the sinuses, remembering that it is not the amount of discharge that does the damage but the lack of drainage with absorption of the discharge that harms the child. The ostium of a child's antrum is relatively larger than that of an adult, and with a small cannula it can be negotiated and the antrum readily irrigated.

*Chief Complaints for Which Operations Were Performed*

| Condition | No. of Cases, 1923–1925 | No. of Cases, 1931–1935 |
|---|---|---|
| Recurrent laryngitis and bronchitis (cough) | 7 | 18 |
| Acute glomerulonephritis | 9 | 4 |
| Pyelitis | 7 | 3 |
| Fever (acute pansinusitis) | 3 | 11 |
| Headache | 1 | 7 |
| Myocarditis (acute) | 2 | 1 |
| Dermatitis | 1 | 1 |
| Hypertrophy of pharyngeal and lingual lymphoid tissue | 1 | 4 |
| Neurosis | 4 | 2 |
| Otitis media (chronic purulent) | 1 | 4 |
| Mastoiditis (acute purulent) | 5 | 3 |
| Arthritis (acute) | 1 | 1 |
| Cyclic vomiting | 2 | 1 |
| Asthma | 7 | 7 |
| Orbital abscess (acute) | 1 | 1 |
| Chorea | 0 | 4 |
| Bronchitis (lymphatic) | 0 | 3 |

The preparation of the autogenous vaccine requires a week, and during this time some form of antigen or protein therapy is administered to increase the immunity, thus assisting the sinuses in their fight against the infection. The autogenous vaccine is given consistently—one series during the fall, another during the winter and a third during the early spring, with sustaining doses whenever there are indications of acute sinusitis. When the pathologic process has been thoroughly established in a child's sinuses, it requires one or two years of constant attention to reestablish the normal functions.

## CONCLUSIONS

1. A well placed catheter drain improves the efficiency of antrostomy in a child.

2. Since the after-treatment is painless, it can be thorough.

# LABYRINTHITIS SECONDARY TO MENINGOCOCCIC MENINGITIS

## A CLINICAL AND HISTOPATHOLOGIC STUDY

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NEW YORK

Deafness is, unfortunately, not an uncommon sequel of meningococcic meningitis. The deafness is usually bilateral and often complete. Not infrequently it is due to labyrinthitis secondary to an extension of infection from the meninges. The exact channel through which the infection is transmitted to the labyrinth cannot always be determined, nor is the pathologic picture in the early stages of the resultant labyrinthitis definitely known. It is assumed that this extension usually takes place either along preexisting routes, such as the nerve tunnels within the internal auditory meatus and the aquaeductus cochleae, or by way of the blood stream.

This report is based on a study of serial sections of temporal bones which showed evidences of early as well as late pathologic changes in the labyrinth secondary to meningococcic meningitis.

### REPORT OF FOUR CASES OF EARLY CHANGES

CASE 1.—L. R., a boy aged 2 years, was admitted to the hospital on Jan. 22, 1929, with a history of malaise, fever, convulsions, a purpuric rash and meningeal signs. The duration of the illness was one day. Culture of the blood showed meningococci in all the mediums. The middle ears were normal. The child died on the day of admission. Postmortem examination revealed hemorrhages in the skin, conjunctiva, peritoneum and adrenal glands.

Histologic examination of the temporal bone showed hemorrhages and purulent exudate in the internal auditory meatus; hemorrhages within, and degeneration of, the organ of Corti, and hemorrhages in the stria vascularis and in the saccule. There was partial displacement of the membranous labyrinth in the semicircular canals.

CASE 2.—J. K., aged 19 months, was admitted to the hospital in a moribund state on March 22, 1929, with a history of fever, cyanosis, vomiting and purpuric rash for three days. Culture of the spinal fluid and of the blood showed meningococci. The middle ears were normal. The child died on the day of admission. Postmortem examination revealed acute purulent meningitis with meningococcemia, and petechiae of the skin, intestines and bladder.

Histologic examination of the temporal bone showed purulent exudate with perivascular infiltrations about the main vessel in the internal auditory meatus, purulent

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From the Otologic Service and the laboratories of the Mount Sinai Hospital.

exudate in the aquaeductus cochleae and atrophy of the organ of Corti. There was a mild inflammatory process in the tympanum. The tympanic membrane was intact.

CASE 3.—A. M., a youth aged 18 years, was admitted to the hospital in a comatose condition on Oct. 20, 1928, with a history of chills, fever, headache, purpuric rash and meningeal signs of one day's duration. The middle ears were normal. Culture of the spinal fluid showed meningococci. The patient died on the third day. Postmortem examination revealed purpuric hemorrhages in the skin, epicardium and conjunctiva.

Histologic examination of the temporal bone revealed recent hemorrhages in the internal auditory meatus and in the cochlea, saccule, utricle and semicircular canals; organized hemorrhages within the labyrinth, and displacement of the endosteal lining. The tympanic cavity was normal.

CASE 4.—E. P., a girl aged 2 months, was admitted to the hospital on March 6, 1929, with a history of fever, vomiting and convulsions for five days. Culture of the spinal fluid showed meningococci. The middle ears were normal. The child

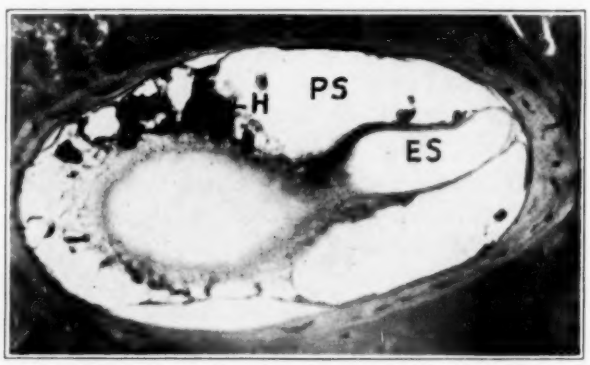


Fig. 1 (case 3).—Section through the external semicircular canal, showing hemorrhagic exudate undergoing organization in, and distortion of, the membranous canal. *ES* represents the endolymphatic space; *H*, hemorrhage, and *PS*, the perilymphatic space.

died at the end of twelve days. Postmortem examination revealed meningococcic meningitis and subpleural hemorrhages in the lung.

Histologic examination of the temporal bone revealed hemorrhagic and purulent exudate, with perivascular infiltration in the internal auditory meatus, hemorrhages in the saccule, serofibrinous exudate in the cochlea (particularly in the first turn), in the vestibule, utricle and semicircular canals and in the aquaeductus cochleae; degeneration of the organ of Corti, and displacement of the membranous portion of the labyrinth. Mild inflammatory changes were present in the tympanum. The tympanic membrane was intact.

*Comment.*—All four cases represent instances of the acute fulminating type of meningococcic meningitis. The condition terminated fatally within from one to seventeen days after the onset of the illness. The pathologic changes in the temporal bone consisted of hemorrhages in the various parts of the labyrinth, including the internal auditory

meatus; atrophy and degeneration of the sensory nerve endings, and serofibrinous exudate in, and distortion of, the membranous labyrinth. Though purulent exudate was present in the internal auditory meatus in three instances, in none did it extend to the labyrinth proper. In this respect the condition differed from labyrinthitis due to the usual Streptococcus meningitidis, in which extension of the purulent exudate to the labyrinth is an early manifestation.

It should be mentioned that the pathologic alterations in the finer labyrinthine structures observed in the four cases just described (degeneration of the organ of Corti and hemorrhages in the labyrinth) could not always be differentiated from artefacts due to postmortem changes. The fact that they occurred with other pathologic changes in such widely distributed areas and the fact that they have been considered by other investigators to be early manifestations of labyrinthitis favor the point of view that they were pathologic. Confirmatory clinical evidence of labyrinthine involvement was not obtained, since these patients were admitted in a more or less moribund state. It must be remembered, however, that diffuse purulent labyrinthitis may be disclosed on postmortem examination in children who showed no evidence of this condition clinically. The hemorrhages in the labyrinth in all four instances may be accounted for on the same basis as the hemorrhages in the various other parts of the body. In the presence of bacteremia, which is common in this disease, hemorrhages are even more frequent. It is strongly suggestive that the alterations in the labyrinth just described are local manifestations of a generalized invasion of the blood stream. They need not be the early evidences of purulent labyrinthitis. In this respect the picture somewhat simulates labyrinthitis secondary to leukemia, pernicious anemia or an allied disease. It is likely that these early pathologic changes frequently resolve without permanent disturbance in function.

Of further interest is the absence of clinical disease of the middle ear in all four cases. Only mild inflammatory changes in the tympanum were observed histologically in two.

### REPORT OF A CASE OF LATE CHANGES

CASE 5.—W. Y., a boy aged 10 years, had an attack of meningococcic meningitis five years previous to his admission to the hospital; it lasted six weeks, and afterward bilateral deafness developed. He was treated in an institution for the deaf, where he remained up to the time of admission to the Mount Sinai Hospital. He was admitted on Nov. 9, 1934, with signs of an acute fulminating bronchopneumonia due to influenza, from which he succumbed at the end of ten hours.

He was born at full term by normal spontaneous labor, and development was normal. He talked at the age of 1 year.

Because of the severity of the illness, tuning fork and vestibular tests were not made by the otologic service. However, routine physical examination by the house staff revealed that he was apparently a deaf-mute. He did not hear or respond to questions.

Inquiry made at the institution where the child resided as to the function of the cochlear and vestibular nerves disclosed the surprising fact that on the last examination, which was made shortly after the attack of meningitis (a 3-A Western Electric audiometer was used) there was a loss of only 20 per cent of hearing in each ear. Speech was apparently unimpaired. Vestibular tests were not performed. No subsequent functional tests were made.

Postmortem examination revealed hemorrhagic influenzal bronchopneumonia. Examination of the brain, with particular attention given to the nerves, revealed no abnormalities.

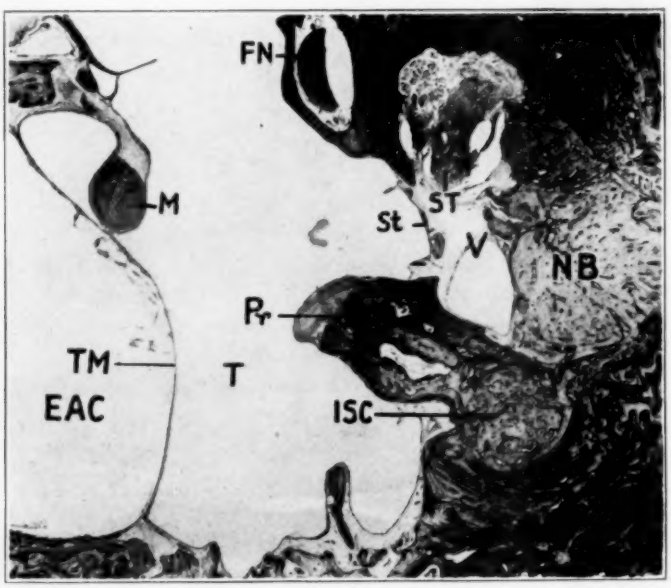


Fig. 2 (case 5).—Section through the tympanum and oval window. The vestibule is partially filled in by new bone, the remainder being occupied by dense scar tissue. The inferior semicircular canal is replaced by new bone. The bony margins of the canal can be made out only with difficulty. Note the new bone on the promontory. *EAC* represents the external auditory canal; *FN*, the facial nerve; *M*, the malleus; *ISC*, the inferior semicircular canal; *NB*, new bone; *Pr*, the promontory; *ST*, scar tissue; *St*, the stapes; *T*, the tympanum; *TM*, the tympanic membrane, and *V*, the vestibule.

Histologic examination of the temporal bone showed that the tympanum and mastoid were essentially normal except for slight engorgement of the vessels in the mucosa lining these spaces. The tympanic membrane was normal.

The labyrinthine spaces, including the cochlear and vestibular portions, were almost completely occupied by newly formed bone (figs. 2, 3 and 4). This was particularly true of the semicircular canals (fig. 5). The endosteum and the other membranous parts of the labyrinth were entirely destroyed, so that the

lymphatic spaces within could no longer be discerned. The few areas in the vestibule and cochlea not replaced by new bone were occupied by dense scar tissue. The newly formed bone within the semicircular canals resembled closely that of the adjacent bony capsule. It was so intimately bound together with the latter that differentiation was extremely difficult. Only at one site, that of the ampullated ends of the external and superior and semicircular canals could the bony capsule be partially outlined. Within the cochlea and vestibule, however, the newly formed bone was more or less sharply demarcated from the capsule. The lamina spiralis ossea and the foot-plate of the stapes were necrosed and replaced by new bone. The secondary tympanic membrane was also partially ossified. The aquaeductus cochleae was occluded, and the ductus endolymphaticus was

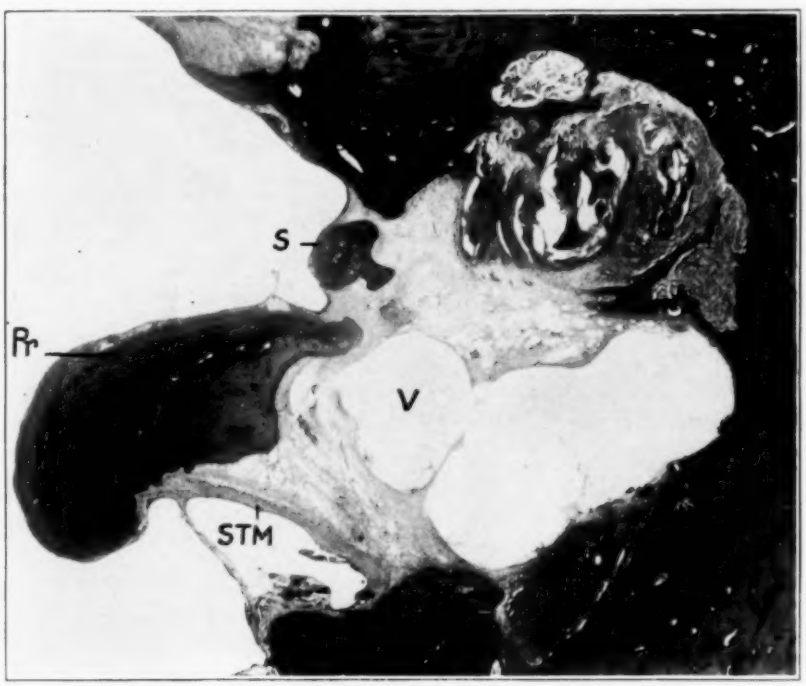


Fig. 3 (case 5).—Vertical section through the oval window, showing organized fibrous and scar tissue within the vestibule. The membranous parts are no longer discernible. Note the new bone formation on the inner aspect of the promontory and stapes. *Pr* represents the promontory; *S*, the stapes; *STM*, the secondary tympanic membrane, and *V*, the vestibule.

traversed by fibrous bands. All the nerve endings within the labyrinth were entirely destroyed. Marked atrophic changes were present in the vestibular and cochlear divisions of the eighth nerve. The cells in the spiral ganglion and in Scarpa's ganglion showed similar alterations.

*Comment.*—The most interesting feature in this case was the pathologic picture presented. The picture was that of the end-result in the process of healing of labyrinthitis secondary to meningococcic menin-

gitis. Almost the entire labyrinthine space was replaced by new bone, the membranous parts as well as the nerve elements having been entirely destroyed. Of further interest was the structure of the newly formed bone within the semicircular canals. With the methods of staining used differentiation of this from the adjacent bony capsule was next to impossible. The latter could no longer be definitely outlined. One had the impression that the picture was that of the end-result of diffuse suppurative labyrinthitis during the early stages of which there was not only destruction of the soft parts but also necrosis of the underlying bony capsule.

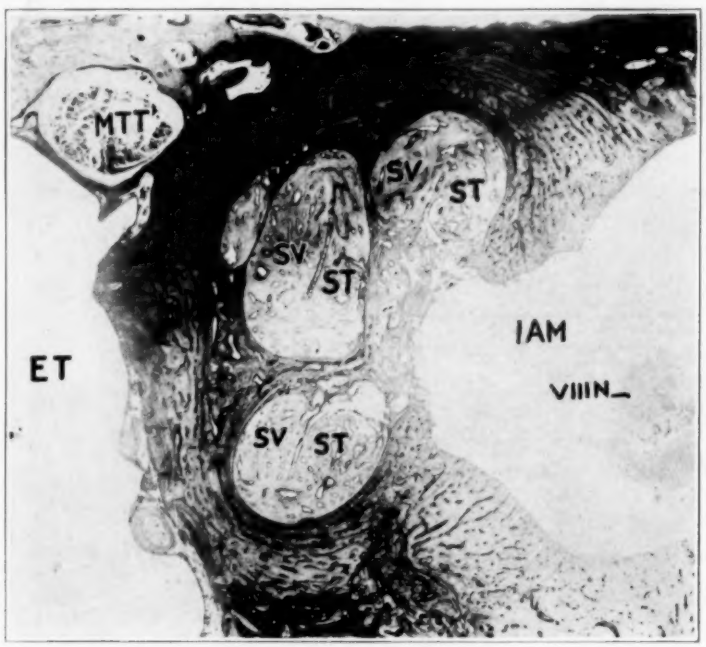


Fig. 4 (case 5).—Section through the internal auditory meatus. The spaces within the cochlea are completely replaced by new bone. The membranous parts can no longer be discerned. The lamina spiralis ossea can still be identified. The new bone is sharply demarcated from the adjacent bony capsule. *ET* represents the eustachian tube; *IAM*, the internal auditory meatus; *MTT*, the tensor tympani muscle; *ST*, the scala tympani; *SV*, the scala vestibuli, and *VIIIN*, the eighth nerve.

Naturally, because of the very late stage of the infectious process this case offered no clue as to the route of extension to the labyrinth, ossification having taken place about the modiolus and within the aquaeductus cochleae. Although extension from the meninges along these routes is most plausible, invasion by way of the blood stream cannot be definitely ruled out.

To correlate the audiometric reading with the pathologic changes is exceedingly difficult. It is hardly conceivable in the face of total destruction of the end-organs and nerves in the cochlea that there should have been a loss of only 20 per cent in the hearing. Total loss of hearing and vestibular function would have been expected. Since the last tests of hearing were made shortly after recovery from the meningitis (five years previously) it is possible that certain uninvolved end-organs in the cochlea continued to function after the attack. These subsequently degenerated either from the continued infection in the labyrinth or from

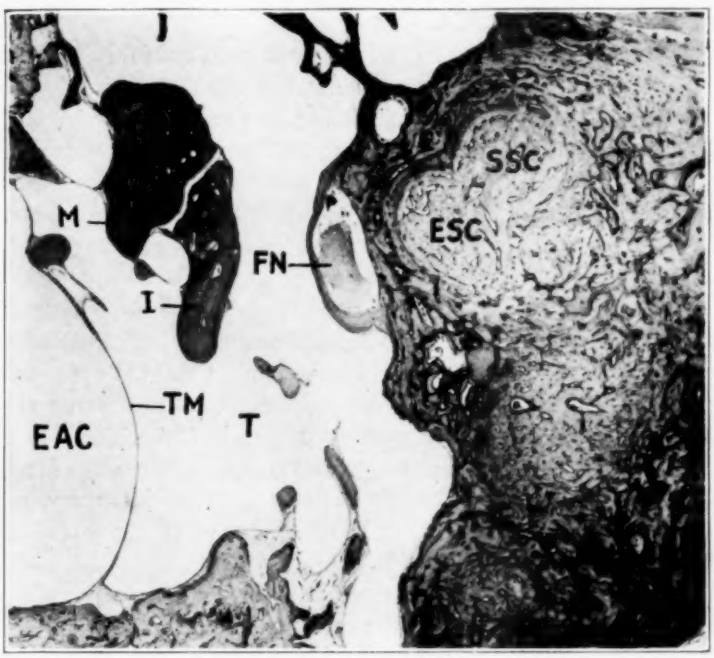


Fig. 5 (case 5).—Section through the tympanum, showing complete bony replacement of the spaces within the ampullated ends of the external and superior semicircular canals. Differentiation of the newly formed bone from the adjacent capsule can be made only with difficulty. *EAC* represents the external auditory canal; *ESC*, the external semicircular canal; *FN*, the facial nerve; *I*, the incus; *M*, the malleus; *SSC*, the superior semicircular canal; *T*, the tympanum, and *TM*, the tympanic membrane.

scarring and new bone formation in the process of healing. This would preclude a diffuse suppurative process in the labyrinth, where it is universally agreed that early destruction of all nerve-endings and soft parts and total loss of labyrinthine function take place.

GENERAL COMMENT

Not in all instances of meningococcic meningitis is the labyrinth involved; nor is the degree of involvement, as determined by functional tests and histologic examination, always the same. There seems to be a diversity of opinion as to the incidence of impairment of hearing following this disease. On the one hand, according to Alexander,[1] some loss of hearing is experienced by about 50 per cent of the patients. An investigation made by the National Research Council in which more than 5,000 children in public institutions for the deaf were examined revealed that in 20 per cent the acquired deafness was secondary to meningitis (cited by Shambaugh and his associates[2]). Urbantschitsch[3] and Alexander[1] stated that meningococcic meningitis is the primary cause of deaf-mutism and is responsible for the condition in one third of the cases. On the other hand, Rollesten and Andrews[4] stated that in 548 cases the incidence of deafness (of the nerve type) was only 5 per cent. Zuckermann,[5] who made a study of aural complications of meningococcic meningitis in a series of 230 children during the epidemic in Charkew, Russia, in 1931, found an incidence of marked or total deafness of only 3.8 per cent. However, he also found among 32 children on whom caloric tests were performed a total loss of irritability in 9 and a diminished reaction in 22. Zuckermann's figures thus show a greater incidence of vestibular involvement than those of previous investigators. Shambaugh and his associates,[2] in a comprehensive clinical study of the causes of severe deafness in 165 adults, found that among the 30 instances of primary nerve deafness in only 5 was the deafness caused by toxic neuritis secondary to an infectious disease. Mention was made of only 1 case in which one labyrinth was dead as a result of meningitis.

The degree of hearing will naturally depend on the structural changes in the labyrinth, particularly in the cochlear end-organs and the accompanying nerves. Pathologic changes take place in these structures at a relatively early stage. The causes for these changes are not definitely

1. Alexander, G.: Die Ohrenerkrankungen bei Meningitis cerebrospinalis epidemica, in Ohren-Krankheiten im Kindesalter, Leipzig, F. C. W. Vogel, 1927, p. 303.

2. Shambaugh, G. E.; Wallner, L. J.; Greene, L. D., and Shambaugh, G. E., Jr.: Severe Deafness in Adults: A Clinical Study, Arch. Otolaryng. **18**:430 (Oct.) 1933.

3. Urbantschitsch, E.: Taubstummheit, in Alexander, G., and Marburg, O.: Handbuch der Neurologie des Ohres, Berlin, Urban & Schwarzenberg, 1924, vol. 2, p. 259.

4. Rollesten, H., and Andrews, F. W.: Cerebrospinal Fever, in Nelson Loose-Leaf Living Medicine, New York, Thomas Nelson & Sons, 1927, vol. 2, p. 45.

5. Zuckermann, M. A.: Aural Complications of Epidemic Cerebrospinal Meningitis, Vrach. delo **16**:706, 1933.

known. They have been ascribed to an extension of the purulent inflammation in the meninges, to toxic action and to localized hemorrhages. Inflammation in the tympanum, which is frequently the cause of labyrinthine disease, can be ruled out as a causative factor in this condition. Certainly, the changes just described may be the only manifestations of labyrinthine involvement; they need not go on to a serofibrinous or purulent process.

The further advanced and more severe inflammations of the labyrinth are characterized by a diffuse serofibrinous, purulent or hemorrhagic exudate. When the exudate is of the diffuse serofibrinous type of exudate, though the membranous parts of the labyrinth are frequently destroyed, the bony capsule is seldom eroded. When it is of the diffuse purulent type of exudate, however, not only are the soft parts destroyed, but the adjacent bony capsule may undergo resorption and necrosis. The entire foot-plate of the stapes may be sequestered.

*Reparative Processes.*—The reparative processes in the labyrinth are essentially the same in labyrinthitis due to meningococcic meningitis as in labyrinthitis due to other causes. The condition is naturally dependent on the severity of the inflammation. In mild inflammations complete regeneration and restitution of function are probably the rule. In more severe inflammations atrophy or total destruction of the neuro-epithelium is frequently the final outcome. In such cases the products of inflammation within the labyrinth (serofibrinous, purulent or hemorrhagic) are organized into fibrous and scar tissue. If the soft parts have not already been displaced or destroyed in the early stages of the inflammatory process they are often subsequently doomed to this fate by scarring or new bone formation.

New bone formation is characteristic of the terminal stage in the process of repair. It is of two types, the metaplastic and the osteoplastic. The former originates from the scar or connective tissue and the latter from the adjacent bony capsule. Consequently, osteoplastic bone is formed only in the event that the endosteal lining is destroyed and the bony capsule exposed. However, metaplastic bone in addition may be produced under the same circumstances. The new bone, particularly if it is of the osteoplastic type, not infrequently appears relatively early in the process of healing. Thus, it has been observed about one month after the onset of the infection in the labyrinth. Though the condition may not be quite comparable, it is interesting to note that in cases of suppuration of the petrous pyramid new bone production is observed in the petrosa at the end of from two to three weeks. It is present not only at the site of active inflammation but also at a considerable distance from it. This is evidence of the important rôle that new bone formation plays in the process of healing.

Not infrequently after meningococcic meningitis the entire labyrinthine space is completely replaced by new bone. The sites of predilection for complete bony occlusion in the order of their frequency are: the semicircular canals, the cochlea and, finally, the vestibule. It will be observed that this sequence is inversely proportionate to the width of the lumen within these structures. The double blood supply to the vestibule is, according to Siebenmann and Mygind,[6] an additional factor to account for its last position on the list. Occasionally the entire fundus of the internal auditory meatus is converted into one solid mass; the niches of the oval and round windows are narrowed, and the tympanic cavity is partially obliterated.

*Prognosis and Considerations of Treatment.*—One should be guarded in prognosticating the final status of hearing. Though only slight impairment of hearing may be present shortly after an attack of meningitis, it may nevertheless eventuate in total deafness. This progression of impairment of hearing is not infrequently due to the reparative processes in the labyrinth.

It is apparent from the various clinical observations and histologic studies that instituting early treatment for the meningitis is of primary importance in possibly warding off labyrinthine complications. Zuckermann found clinically that 23 per cent of the aural complications occurred in the first week of the illness and 77 per cent in the second week or later. Pathologic manifestations within the labyrinth were observed by my associates and me and by other investigators within the first week. Though the routes of extension to the labyrinth are not definitely known, there is evidence to support the point of view that extension takes place not only by way of the cerebrospinal fluid but also via the blood stream. It would therefore seem logical that treatment be administered through both these channels at a very early date, particularly if there is evidence of invasion of the blood stream.

## SUMMARY

A histologic study of 5 temporal bones from 5 patients with meningococcic meningitis was made. The clinical and histopathologic features of labyrinthitis secondary to this disease are reviewed; the routes of extension to the labyrinth, the early and late pathologic changes and the reparative processes are discussed, and a rationale for therapy, deduced from clinical and histopathologic observations, is suggested.

6. Siebenmann and Mygind, cited by Denker, A.: Die pathologische Anatomie der Taubstummheit, in Denker, A., and Kohler, O.: Handbuch der Hals-Nasen-Ohrenheilkunde, Berlin, Julius Springer, 1927, vol. 8, p. 386.

# SEPTIC AND ASEPTIC TYPES OF THROMBOSIS OF THE CAVERNOUS SINUS

## REPORT OF CASES

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Although my study concerns itself chiefly with the aseptic types of thrombosis of the cavernous sinus, I shall be obliged to cover all the phases of this subject.

### ANATOMIC CONSIDERATIONS

The sinuses of the dura mater [1] are venous channels lying between the inner and the outer layer of the dura. They are rigid tubes, which always remain open.[2]

The cavernous sinuses, two in number, lie on each side of the sphenoid bone [3] and extend from the inner end of the sphenoid fissure to the apex of the petrous portion of the temporal bone. They are of considerable size and of very irregular form. Their cavity is traversed by numerous interlacing filaments, which give rise to a reticulated structure resembling that of cavernous tissue. These partitions may give rise to from one to fourteen separate cavities.[4] Enclosed in the outer wall of each cavernous sinus [3] are the third and fourth cranial nerves and the ophthalmic and superior maxillary divisions of the fifth cranial nerve as they pass forward to the sphenoid fissure and the foramen rotundum. Within the cavity of the sinus, covered only by its thin membrane, are the internal carotid artery, the sixth nerve and a plexus of the sympathetic nervous system. The two cavernous sinuses are joined by two or three transverse sinuses, called the circular sinuses. These, together with the cavernous sinuses, completely surround the pituitary body.

Internally, the cavernous sinus is in direct apposition to the pituitary body. External to the sinus lies the gasserian ganglion. Inferiorly,[5]

1. Langworthy, H. G.: Thrombosis of the Cavernous Sinuses with Report of Four Cases, Boston M. & S. J. **156**:528, 1907.

2. Macewen, W.: Pyogenic Infective Diseases of the Brain and Spinal Cord, Glasgow, J. Maclehose & Sons, 1893.

3. Mosher, Harris P.: The Orbital Approach to the Cavernous Sinus, Laryngoscope **24**:709, 1914.

4. Halstead, cited by Langworthy.[5]

5. Langworthy, H. G.: Anatomic Relations of the Cavernous Sinus to Other Structures, with Consideration of Various Pathological Processes by Which It May Become Involved, Ann. Otol., Rhin. & Laryng. **25**:554, 1916.

in the greatest part of its course the cavernous sinus overlaps the roof of the sphenoid sinus and is separated from this air cavity by the thinnest of bony partitions. According to the results of an examination of 85 sphenoid sinuses by Gibson,[6] the thickness of this bony partition varies from 0.25 to 2 mm. Dehiscences between the sphenoid sinus and the carotid canal have been observed by Beck [7] and others. Thomson,[8] quoting from Zuckerkandl, stated that this wall may at times have such defects that the mucosa of the sinus lies in actual contact with the dura. Anteriorly, the cavernous sinus lies in close connection with the optic chiasm and the sphenoid fissure and, posteriorly, with the apex of the petrous portion of the temporal bone.

The afferent tributaries of the cavernous sinus [9] are both intracranial and extracranial. The intracranial tributaries are: (1) the sphenoparietal sinus from the lesser wing of the sphenoid, (2) the superficial inferior cerebral veins and (3) the intercavernous plexus of veins. The extracranial afferent tributaries are: (1) the superior and inferior ophthalmic veins and (2) the sphenoid veins. The superior ophthalmic vein communicates with the frontal, the supra-orbital and the angular vein. The inferior ophthalmic vein communicates with the angular vein and with the pterygoid plexus of veins. Both the anterior and the posterior facial veins, which are in direct connection with the ophthalmic veins, also communicate with the pterygoid plexus. The pterygoid plexus is in direct communication with the cavernous sinus by way of the vein of Vesalius.

The efferent vessels of the cavernous sinus are: (1) the vein of Vesalius to the pterygoid plexus, (2) the veins of the foramen ovale and the foramen lacerum to the pterygoid plexus, (3) the carotid venous plexus to the internal jugular vein or the pharyngeal plexus and (4) the superior and inferior petrosal sinuses. The superior petrosal sinus, the smaller of the two, empties into the transverse or lateral sinus, and the inferior petrosal sinus empties into the jugular bulb.

In addition to these afferent and efferent connections of the cavernous sinus, there is an interlacing plexus of veins lying on the upper surface of the basisphenoid, sometimes extending almost to the foramen magnum, which cross from the petrosal sinuses of one side to those of the other.

All the veins communicating with the cavernous sinus as either afferent or efferent tributaries are valveless, which is an important factor

6. Gibson, cited by Langworthy.[5]

7. Beck, J. C., cited by Langworthy.[5]

8. Thomson, St. Clair: The Causes and Symptoms of Cavernous Sinus Thrombosis, Ophth. Rev., London **27**:293, 1908.

9. Turner, A. Logan, and Reynolds, F. Esmond: Intracranial Pyogenic Diseases, Edinburgh, Oliver & Boyd, 1931.

in studying thrombosis of the cavernous sinus and its connecting system of veins, as retrograde thrombosis develops much more easily in valveless veins.

From the foregoing description of its venous connections it is apparent that the cavernous sinus, through its afferent and efferent venous channels, is brought into relation with the tonsil, the soft palate, the pharynx, the posterior portions of the superior and inferior alveolar arches, the face, the orbit, the nose and all its sinuses, the ear and the mastoid.

## HISTORICAL CONSIDERATIONS

The first case of thrombosis of the cavernous sinus observed at autopsy was described by Duncan in 1821.[10] The first clinical report of the condition was made by Vigla in 1839.[10a] While the condition is not rare, neither is it extremely common. In 1902 Dwight and Germain[11] surveyed the literature and collected reports of 178 cases, to which they added 4 instances of their own, and in 1918 Dorland Smith[12] estimated that less than 300 cases had been reported since the disease was first recognized. In 1920 Chisolm and Watkins[10a] surveyed the surgical records at the Johns Hopkins Hospital and found reports of only 8 cases among 50,000 surgical records covering the period from 1889 to 1919. In 1926 Eagleton[13] reported 25 cases of his own. The same year 8 cases were reported by Dixon,[10b] and in 1931 Turner and Reynolds[9] studied 20 cases of their own and also the cases of other investigators, bringing the total of the cases studied by them up to 55. So the total number of cases which have been reported is not much in excess of 400. Dixon[10b] stated the belief that many cases have been overlooked, and Eagleton[13] expressed the opinion that this condition is much more frequent than the recorded number of cases would indicate, because the cavernous sinus is not always carefully examined at autopsy in obscure cases of septicemia.

Cavernous sinus thrombosis can occur at any age, the youngest patient on record being an infant 3 weeks old, whose case was reported

10. (*a*) Chisolm, J. Julian, and Watkins, S. Shelton: Twelve Cases of Thrombosis of the Cavernous Sinus, Arch. Surg. **1**:483 (Nov.) 1920. (*b*) Dixon, O. Jason: The Pathologic Examination in Cavernous Sinus Thrombosis, J. A. M. A. **87**:1088 (Oct. 2) 1926.

11. Dwight, E. W., and Germain, H. H.: Thrombosis of the Cavernous Sinus, with Report of Four Cases, Boston M. & S. J. **146**:456, 1902.

12. Smith, Dorland: Cavernous Sinus Thrombosis, with Notes of Five Cases, Arch. Ophth. **47**:482, 1918.

13. Eagleton, Wells: Cavernous Sinus Thrombophlebitis and Allied Septic and Traumatic Lesions of the Basal Venous Sinuses, New York, The Macmillan Company, 1926.

by Lederer.[14] The autopsy in this case of fulminating nasal infection revealed a thrombus in the cavernous sinus.

### ETIOLOGY

The three most common causes of thrombosis of the cavernous sinus are as follows:

1. The marasmic type of thrombosis, which occurs in debilitating conditions at the extremes of life.[15] Macewen [2] expressed the belief that this type of thrombosis of the cavernous sinus is never primary in the cavernous sinus itself but is always secondary to thrombosis in the longitudinal or lateral sinus. This kind of thrombus is always sterile.

2. The traumatic type of thrombosis.[16] In these cases the thrombi, which result from a blow on the head, fracture of the skull, direct trauma to the cavernous sinus by a puncture wound or an operative accident, are sterile. Cushing [17] reported a case in which the cavernous sinus was accidentally injured during an operation on the gasserian ganglion and had to be packed to stop hemorrhage. The thrombosis in the sinus occurred one month after the operation.

Coupland [18] reported 4 cases in which the condition was due to external violence to the head. In replies to a questionnaire sent out by Langworthy [5] to 284 American surgeons in 1916, 6 cases of thrombosis of the cavernous sinus due to fracture of the base of the skull were reported. Two of the 6 patients recovered. In the replies to the same questionnaire there were reported 3 cases of accidental injury to the cavernous sinus during operation, 2 of injury during an operation on the gasserian ganglion, with good recovery, and 1 of injury during an operation for a pituitary tumor. The last patient died of intracranial hemorrhage. Among the cases of traumatic thrombosis of the cavernous sinus of the aseptic type must be included those in which, through trauma or for other reasons, the carotid artery ruptures within the cavernous

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14. Lederer, Francis L.: Fulminating Sinus Disease, Surg., Gynec. & Obst. **60**:645, 1935.

15. (*a*) Ballance, C. A., and Hobhouse, N.: A Case of Septic Thrombosis of the Left Sigmoid, Left Cavernous, and Left Inferior Petrosal Sinuses, Ann. Otol., Rhin. & Laryng. **21**:942, 1912. (*b*) Chisolm and Watkins.[10a] (*c*) Dwight and Germain.[11]

16. (*a*) Knapp, Hermann: A Case of Traumatic, at First Doubtful, Orbital Sarcoma Followed by Aseptic Thrombosis of the Cavernous Sinus, Arch. Ophth. **29**:463, 1900. (*b*) Langworthy.[5] (*c*) Chisolm and Watkins.[10a] (*d*) Dwight and Germain.[11] (*e*) Smith.[12] (*f*) Ballance and Hobhouse.[15a]

17. Cushing, Harvey: The Surgical Aspects of Major Neuralgia of the Trigeminal Nerve, J. A. M. A. **44**:773 (March 11) 1905.

18. Coupland, Sidney: On a Case of Ophthalmoplegia Dependent upon Thrombosis of the Cavernous Sinus, Tr. Ophth. Soc. U. Kingdom **7**:228, 1887.

sinus and produces an arteriovenous communication or aneurysm, for sooner or later thrombosis occurs in these cases. My case 3 is an example of this condition. Eagleton [13] reported such a case in his series, and in the replies to the questionnaire of Langworthy [5] 15 such cases were reported. In this series there were also 8 cases of gunshot wounds in which the sinus had been badly injured. In practically all the cases in which the condition is due to trauma the thrombus is sterile.

3. The infective or inflammatory type of thrombosis of the cavernous sinus. This is by far the most common variety encountered. It is usually secondary to thrombophlebitis in the afferent or efferent veins of the cavernous sinus. It may, however, be primarily due to direct extension in cases of basilar meningitis, an abscess in the postorbital space, suppurative sphenoiditis or suppuration of the petrous portion of the temporal bone. Zörkendörfer [19] expressed the opinion that infection could also travel from the sphenoid sinus to the cavernous sinus by way of lymphatic channels, but most authors are agreed that the cavernous sinus is infected either by way of its afferent and efferent venous communications or by direct extension from contiguous parts. Among 22 cases studied by Turner and Reynolds [9] the venous blood stream was the sole pathway in 13. In 8 cases there was first direct extension through bone, and the infection finally reached the cavernous sinus by the venous system.

Thrombosis of the cavernous sinus of infective or inflammatory origin may be further subdivided according to the virulence of the course. Eagleton [13] divided his 25 cases into two main groups: those in which the infection was of an acute fulminating type, of which there were 17 cases, or 68 per cent, and those in which the infection was of a chronic compensatory type, of which there were 8 cases, or 32 per cent. Turner and Reynolds [9] also classified their cases as those in which the infection was of an acute, often fulminating type, in which clotting occurred rapidly and the clot became infected almost as rapidly as it formed, and those in which the infection was of a chronic or restrained type, in which the original infection might be controlled so that recovery occurred in certain cases.

In the acute fulminating type, whether the thrombosis of the cavernous sinus is caused by an infected embolism lodging in it or by gradual extension of thrombophlebitis in one of its tributary venous channels, the infection always reaches the sinus from its afferent vessels. This infection is rapid, and the resulting thrombus is already infected as it forms or is infected soon thereafter. The process is overwhelming and

19. Zörkendörfer: Prag. med. Wchnschr. **18**:209, 1893.

soon involves the meninges, and in from four to twenty days [20] death invariably ensues.

On the other hand, in the slow, compensatory type of infection in which the thrombosis is retrograde and reaches the cavernous sinus through its efferent vessels, the thrombus at the time of its formation is sterile, even though the thrombus in the lateral sinus, jugular bulb, petrous sinuses or carotid plexus may already be infected. In cases of this condition the patient may recover if the original infective focus is vigorously dealt with. These are the usual cases of aural infection. That the slow compensatory type of infection may at times be caused by direct extension through the neighboring bone of the superior wall of the sphenoid sinus and the apex of the petrous pyramid, either with or without intervention of the venous system, is evident from the reports of Bircher,[21] Arnold Knapp,[22] Thomson [23] and Turner and Reynolds.[9] The marked chronicity in some of the cases of the restrained type of infection is illustrated by a case of Kolb's,[24] in which the symptoms lasted for three and one-half months, until the patient was discharged from the hospital as cured.

According to the original focus of the infection and the route taken by the infection to the cavernous sinus, the cases may be further classified, as has been done by Eagleton, into the following groups:

1. Cases of infection by the ophthalmic route (infection of the anterior portion). In these cases the infection, which is usually staphylococcic, originates in the lips, eyelids or nares or in the anterior part of the mouth. This is also the usual route in infection of the ethmoid sinuses in which the orbit is perforated.

2. Cases of infection by way of the pterygoid plexus (infection of the antero-inferior portion). In these cases the infection comes from below by way of the pterygoid plexus. The foci are in the posterior teeth, in the antrum or the jaw or, less frequently, in the tonsils or the pharynx.

3. Cases of infection by way of the sphenoid bone (infection of the mesial portion). In these cases the infection involves the cavernous sinus by direct extension through caries of the sphenoid bone or by thrombophlebitis of the sphenoid veins.

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20. Dixon,[10b] Eagleton.[13]

21. Bircher, Heinrich: Phlebitis des Sinus transversus, petrosus inferior und cavernosus, Centralbl. f. Chir. **20**:483, 1893.

22. Knapp, Arnold: Primary Cavernous Sinus Thrombosis Secondary to Osteomyelitis of the Petrous Pyramid, Arch. Otol. **35**:437, 1906.

23. Thomson, St. Clair: Cerebral and Ophthalmic Complications in Sphenoidal Sinusitis, Brit. M. J. **2**:768, 1906.

24. Kolb, Karl: Ein Fall von Hirn Sinus Thrombose, Berl. klin. Wchnschr. **13**:662, 1876.

4. Cases of infection by the aural route (infection of the posterior portion). The infection enters the posterior portion of the sinus in three ways: first, by retrograde thrombosis of the petrosal sinuses; second, by retrograde thrombosis of the carotid plexus, and, third, by direct extension in cases of caries of the deep cells of the petrous apex.

5. Cases of infection by way of the tonsils (infection of the postero-inferior portion). In these cases the infection reaches the cavernous sinus through the pterygomaxillary fossa by ascension in cases of thrombophlebitis of the jugular vein. Thrombosis of the tonsillar vein extends through the superior constrictor muscles, giving rise to thrombophlebitis of the jugular vein, which retrogrades into the jugular bulb and then to the cavernous sinus by way of the inferior petrosal sinus.

6. Cases of infection by way of the carotid venous plexus (infection of the internal portion). These are also cases of aural infection, but the infection passes directly into the lumen of the cavernous sinus through thrombophlebitis of the venous plexus surrounding the internal carotid artery. Cases described by Brunner [25] and Eagleton [26] prove rather conclusively that thrombophlebitis arising from aural suppuration can reach the cavernous sinus by this route.

As to the focus of the suppuration which gives rise to thrombosis of the cavernous sinus, Macewen [2] placed the ear first, then the orbit and then the face. Among 25 cases of Eagleton's [13] series, in 10 the condition resulted from infections of the face, eyelids, nasal orifice or teeth; in 4, from infections of the antrum or ethmoid sinuses; in 1, from infection of a gland of the neck; in 3, from infection of the sphenoid sinus,[11] and in 7, from infection of the ear. In Dwight and Germain's series, in 43 cases the focus of infection was in the ear, in 40 in the face or the orbit, in 14 in the mouth or the throat and in 9 in the nose. In the series of Edward Jackson [27] the ear was responsible in 13 cases, the orbit or the face in 6 and the mouth or the teeth in 2; in 4 the condition was ascribed to other causes. In his series of cases Dorland Smith [12] assigned the focus of infection to the orbit or the face in 3 cases, to the mouth or the teeth in 2 cases and to the nose in 4 cases. In making a composite table of these various series, Smith found that in 40 per cent of all the cases the focus of infection was in the ear; in 35 per cent, in the orbit or the face; in 13 per cent, in the mouth or the teeth, and in 9 per cent, in the nose, while in 3 per cent other sources were responsible.

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25. Brunner, Hans, cited by Turner and Reynolds.[9]

26. Eagleton, Wells, cited by Turner and Reynolds.[9]

27. Jackson, Edward: Ocular and Orbital Symptoms of Cavernous Sinus Thrombosis, Ophthalmology **5**:185, 1909.

With regard to the frequency with which the individual nasal sinuses are affected in sinusal infection complicated by thrombosis of the cavernous sinus, Boenninghaus [28] reported in 1913 that in a series studied by him the frontal sinuses were involved in 6 cases, the antrum in 1 case, the ethmoid sinuses in none and the sphenoid sinus in 24 cases. St. Clair Thomson [8] placed infection of the sphenoid sinus as the most frequent cause of thrombosis of the cavernous sinus. He collected reports of 16 cases from the literature. He placed pyogenic aural infection as the second most common cause. Infections carried by the ophthalmic vein were placed next in importance. Last in importance he placed infections carried by the pterygoid plexus, and he thought that this route was sometimes suggested on insufficient evidence. In Turner and Reynold's [9] classification of foci in their series they gave infection in the face as responsible in 4 cases, infection in the sinuses as responsible in 12 cases, infection in the tonsils as the source in 1 case and infection in the ear as responsible in 5 cases. In 9 of their 12 cases in which the condition was due to sinusal infection, the focus was in the sphenoid sinus.

Very interesting is the question of the lighting up or acute exacerbation of a chronic suppurative focus by an acute intercurrent infection, with the resulting production of thrombosis of the cavernous sinus from this chronic focus. Fabricant [29] reported a case of acute sepsis, thrombosis of the cavernous sinus and meningitis, which occurred after resection of the nasal septum. The autopsy revealed an acute purulent meningitis and bilateral thrombosis of the cavernous sinus, and the ethmoid and sphenoid sinuses of both sides were filled with thick creamy pus. Undoubtedly the operative intervention in this case lighted up the chronic focus of infection in the paranasal sinuses. E. E. Jack [30] reported a case in which the symptoms of thrombosis of the cavernous sinus appeared after an acute attack of grip, and the autopsy showed the presence of empyema of the sphenoid sinuses. Eagleton [13] also expressed the opinion that an acute intercurrent disease, such as acute tonsillitis or acute otitis, may light up a dormant infection elsewhere. In a fatal case reported by Finlay [31] the acute condition was otitis media,

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28. Boenninghaus, in Katz, L.; Preysing, H., and Blumenfeld, F.: Handbuch der speziellen Chirurgie des Ohres und der oberen Luftwege, Würzburg, C. Kabisch, 1913, p. 237.

29. Fabricant, N. D.: Cavernous Sinus Thrombosis Following Submucous Resection, Arch. Otolaryng. **17**:635 (May) 1933.

30. Jack, E. E.: A Case of Cavernous Sinus Thrombosis Following Grippe, Arch. Ophth. **31**:578, 1902.

31. Finlay, C. E.: A Case of Thrombophlebitis of the Cavernous Sinus Complicating an Empyema of the Sphenoidal Sinuses and Ethmoidal Cells, Mistaken for a Thrombophlebitis of the Lateral Sinus, Arch. Otol. **32**:419, 1903.

whereas the autopsy did not show pathologic changes in the ear or mastoid but revealed thick yellow pus in the sphenoid and ethmoid sinuses. Jaques and Lucien [32] ascribed the condition in their case to a peritonsillar abscess and thought that the route of the infection was by way of the peripharyngeal plexus of veins. The autopsy revealed osteomyelitis of the sella turcica and of the tip of the petrous portion of the temporal bone.

Interesting also is the question of the influence of trauma to the original focus of infection in the production of thrombophlebitis which ultimately reaches the cavernous sinus. Morgenstern [33] and others have reported cases of thrombosis of the cavernous sinus which followed extraction of a tooth. Eagleton [13] felt that in 5 of his 17 cases of the acute fulminating type trauma, such as opening pimples or boils, played a distinct rôle. In his report of 8 fatal cases Dixon [10b] stated that trauma is usually an associated factor in these cases of infective thrombosis. Dwight and Germain [11] also felt that trauma to the original focus was a factor in the fatal termination in 2 of their 4 cases.

Having once been called in consultation to see a young man in whom the opening of a carbuncle of the upper lip was followed rapidly by death, with symptoms of meningitis, I have long held that trauma to acute infective processes in regions from which the venous blood drains into the cavernous sinus should be avoided. To be sure, meningitis supervened so rapidly in this case that the usual symptoms of thrombosis of the cavernous sinus had no time to develop, and permission for an autopsy was refused, but I have always felt that the infection reached the meninges by the venous blood channels and that the incision of the carbuncle was a causative factor in the rapid, fulminating course.

Staphylococcus albus or Staphylococcus aureus is the organism usually responsible for fatal thrombosis of fulminating type in which the cavernous sinus is affected by way of its afferent vessels. Browder and Myerson,[34] E. R. Lewis [35] and Morgenstern [33] all recovered Staphylococcus in their cases. Eagleton [13] found this to be the usual pathogenic organism in the majority of his cases in which the condition was by the ophthalmic route (infection of the anterior portion). Dixon [10b] recovered Staphylococcus in 6 of 7 cases, and in reports of 9 fatal cases collected from the literature by Turner and Reynolds [9] Staphylococcus was the offender in every instance.

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32. Jaques and Lucien, cited by Thomson.[8]

33. Morgenstern, B. P.: Cavernous Sinus Thrombosis of Dental Origin, Arch. Otolaryng. **21**:442 (April) 1935.

34. Browder, J., and Myerson, M. C.: A Surgical Method for the Prevention of Thrombophlebitis of the Cavernous Sinus, Arch. Otolaryng. **21**:574 (May) 1935.

35. Lewis, E. R.: Cavernous Sinus Thrombosis: Recovery Confirmed by Autopsy Three Years Later, Tr. Am. Laryng., Rhin. & Otol. Soc. **40**:378, 1934.

SYMPTOMATOLOGY

"The causes of thrombosis of the cavernous sinus are chiefly found in diseases of the nose and ear, and therefore come within the dominion of the oto-rhinologist. The symptoms are more prominent and distinctive in the eye, and hence fall largely under the observation of the ophthalmic surgeon" (St. Clair Thomson [8]). The symptoms may present the classic picture described in textbooks and usually do in the acute fulminating type of thrombosis. On the other hand, they may be evanescent and atypical in the more slowly developing compensatory types of the condition. The typical symptoms may be considered under three heads: (1) those due to venous obstruction, (2) those due to involvement of neighboring nerves and (3) those due to general sepsis.

1. The symptoms due to venous obstruction are exophthalmos, edema of the eyelids and of the bridge of the nose, chemosis of the bulbar conjunctiva, some edema of the retina, dilatation and tortuosity of the retinal veins, retinal hemorrhages and at times slight choking of the disk. According to Edward Jackson,[27] exophthalmos usually occurs first and is followed later by swelling of the lids and chemosis. These symptoms of venous obstruction usually make their appearance in the second eye within forty-eight hours, but this is not always the case.

On first thought it seemed rather remarkable that more signs of venous stasis in the eye itself are not encountered in association with more or less sudden occlusion of the cavernous sinus. The paucity of these changes has been noted by Langworthy,[36] H. Knapp,[16a] Chisolm and Watkins,[10a] Stocker,[37] A. Knapp,[22] Jansen,[38] Edward Jackson,[27] Dixon,[10b] Coupland [18] and others. In explanation of this fact Stocker stated:

> When the cavernous sinus and ophthalmic veins are occluded a considerable amount of blood from the central retinal vein may escape through its anastomoses with other veins, and if the quantity of blood which enters through the central artery be reduced by the great increase of intra-orbital pressure it can be understood how this smaller quantity of blood may escape without inducing a choked disc.

In reference to the absence of changes in the fundus Lauber [39] stated:

> Intra-ocular changes are not frequent and are generally a sign of complications, especially of inflammatory nature. The central vein of the retina sometimes opens directly into the cavernous sinus; in other cases it communicates with the superior ophthalmic vein, in others with the inferior vein or with a venous plexus

36. Langworthy, H. G.: Optic Neuritis in Thrombosis of the Cranial Sinuses and Internal Jugular Vein, Laryngoscope **17**:71, 1907.

37. Stocker, Friederich: A Rare Case of Thrombosis of the Cavernous Sinus Following Orbital Thrombophlebitis, Arch. Ophth. **35**:373, 1906.

38. Jansen, A.: Encyclopedie der Ohrenheilkunde, Leipzig, F. C. W. Vogel, 1900, p. 369.

39. Lauber, Hans: Personal communication to the author.

in the posterior part of the orbit. Only in the first case will thrombosis of the cavernous sinus lead to obstruction in the venous circulation of the retina. In all other cases the anastomoses with different veins makes it possible for venous blood to escape without difficulty even when the sinus is thrombosed.

When the pterygoid plexus is occluded along with the cavernous sinus there may be unilateral edema of the pharynx or of the tonsil (Chisolm and Watkins [10a]).

2. The symptoms due to involvement of cranial nerves are ptosis, dilatation of the pupil, paralysis of the abducens nerve, restriction of the movements of the bulb, loss of vision, pain in the regions supplied by the ophthalmic branch of the fifth cranial nerve and, rarely, trismus. The condition of the pupils may vary greatly in different cases and even at different times in the same case. The vision may vary from normal acuity to complete blindness.[40] Jackson [27] found that it is hard to differentiate between slight impairment of the action of the extra-ocular muscles and fixation of the bulb caused by orbital swelling.

3. The symptoms of sepsis are a septic temperature; a rapid, small and thready pulse; chills and sweats, and also frequently vomiting, delirium and coma. Often meningitis supervenes early. Symptoms of pulmonary embolism, infarcts of the kidney, spleen and liver and septic emboli in various parts of the body appear. At times the symptoms of thrombosis of the cavernous sinus are masked by those of the original focus, especially when this lies in the orbit.

Whereas the outspoken symptoms of the classic picture can hardly be mistaken for those of any other condition, the symptomatology of the atypical forms is much more elusive, and atypical thrombosis of the cavernous sinus presents problems in diagnosis, as does atypical thrombosis of the lateral sinus. This atypical picture is not seen in cases of the acute fulminating septic type but is more likely to make its appearance in cases of the slow compensatory type of infective origin, in those of the traumatic type and in cases of arteriovenous aneurysm between the carotid artery and the cavernous sinus, as in my case 3. The signs of venous obstruction may be minimal and evanescent. There may be only occasional and intermittent edema of the lids, with no proptosis. In cases of the chronic type proptosis is notably intermittent, according to Jackson,[27] and after its first appearance it may subsequently diminish even in the fatal cases, as in that of Henderson.[41] The diplopia occasioned by transitory involvement of an extra-ocular muscle, usually the external rectus muscle, may also be of very short duration. Naturally, in the aseptic type of involvement of the cavernous sinus symptoms of sepsis are absent.

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40. Thomson.[8] Jackson.[27]

41. Henderson, F. L.: Thrombosis of the Cavernous Sinus, Am. J. Ophth. 3:65, 1907.

DIAGNOSIS

When exophthalmos of one eye followed by swelling of the lids and chemosis of the bulbar conjunctiva makes its appearance on the side of the body on which there is a preexisting focus of infection, particularly within the area of the afferent and efferent venous connections of the cavernous sinus, the diagnosis of thrombosis of this sinus is not difficult. This diagnosis is rendered definite by the occurrence of the same symptoms in the second eye, which is usually noted within the next forty-eight hours.[42] Jackson [27] stated the belief that involvement of both eyes is an important diagnostic point in differentiating thrombosis of the cavernous sinus from orbital cellulitis and affirmed that "in cases which remain unilateral throughout the diagnosis may be questioned until confirmed by autopsy." In spite of this dictum Jackson included in his own series of cases some in which but one orbit was affected.

While involvement of the second eye is an important diagnostic point in differentiating thrombosis of the cavernous sinus from orbital cellulitis in cases in which this sinus is infected through its afferent veins, especially those of the acute fulminating type, the opinion expressed by Jackson which has just been quoted is not quite correct, as a survey of the literature shows. Only one eye was involved in cases reported by Dwight and Germain,[11] Langworthy,[1] H. Knapp [16a] and Dixon,[10b] in all of which cases the diagnosis was confirmed at autopsy. Dixon reported a case of thrombosis of the cavernous sinus following extraction of a tooth, in which the symptoms came on in one eye only. Because of the recession of the exophthalmos in this eye and the noninvolvement of the other eye, Dixon withdrew the diagnosis of cavernous sinus thrombosis, and yet the section revealed complete liquefaction of a thrombus in one sinus and no involvement of the other. Of note also in this connection is the case of Cushing,[17] who injured one cavernous sinus during an operation on the gasserian ganglion. In this patient also all the symptoms and signs of thrombosis of the cavernous sinus occurred, but only one eye became involved. However, generally speaking, the diagnosis of the septic type is made certain with the involvement of the second eye.

According to Morgenstern,[33] a differential diagnosis should exclude cellulitis of the cheek and face accompanied by edema of the eyelids, orbital cellulitis, infections of the accessory sinuses, exophthalmic goiter and tumors of the orbit, optic nerve and lacrimal gland. The differentiation from orbital cellulitis may at times present extreme difficulties, as has been pointed out by Dixon [10b] and others, unless the second eye becomes involved. Chisolm and Watkins [10a] expressed the belief that in cases of orbital cellulitis, tenonitis and thrombophlebitis of the orbital veins one may encounter a history of previous ocular trouble and that

42. Smith.[12] Bircher.[21] Jackson.[27]

there are more inflammatory signs in the eye than are usually encountered in thrombosis of the cavernous sinus. They also stated that the signs of venous obstruction are likely to be less marked in these conditions.

Septic thrombosis of the cavernous sinus should be further differentiated from other pathologic conditions within the sinus, such as injuries from gunshot wounds; injuries from fractures of the base of the skull and from injuries of the head not associated with fracture of the skull; injuries from operation on the gasserian ganglion, the pituitary gland or the sphenoid sinus; arteriovenous aneurysms; malignant or congenital neoplasms in the neighborhood of, or involving, the sinus; the marasmic or aseptic thrombosis of old age and debilitated states, and also, perhaps, intermittent exophthalmos.

A review of the mortality from this condition presents a rather black and awe-inspiring picture. In a series of 182 cases Dwight and Germain [11] reported a mortality of 92.3 per cent. Henderson [41] estimated the mortality as 92.2 per cent. The recoveries as reported by other investigators are: 5 per cent, Turner and Reynolds; [9] 7 per cent, Dorland Smith; [12] 8.33 per cent, Chisolm and Watkins; [10a] 9.6 per cent, Langworthy,[8] and 16 per cent, Eagleton.[13] On the other hand, in all the 8 cases encountered by Dixon [10b] the patient died. The mortality, however, is probably considerably higher than these figures indicate, for while nearly all the cases in which the patient recovered have been reported in the literature, the same cannot be said of all the cases in which the patient died, and, as Eagleton [13] has pointed out, many more cases would be unearthed if a careful study were made at autopsy of the region of the cavernous sinus in every obscure case of sepsis. In the patients who recover the sinus may recanalize, as was shown in the case observed by Lewis.[35] This was a case of bilateral thrombosis of the cavernous sinus arising from a pimple on the face. Bacteremia due to Staph. aureus, toxic encephalitis and acute meningitis also developed. The patient recovered except for blindness of the left eye. He died three years later from acute mastoiditis complicated by an abscess of the brain. At autopsy fibrous tissue was present throughout the left cavernous sinus, with the formation of new and irregular lumens lined with endothelium. These were numerous and contained blood. The right cavernous sinus revealed only moderate chronic perisinuous inflammatory changes not involving the lumen of the sinus.

## TREATMENT

The black pessimism which prevails regarding the treatment of this formidable condition was expressed by Macewen,[2] who in 1893 concluded that in these cases the condition was beyond cure by surgical intervention. Morgenstern,[33] Dixon,[10b] Chisolm and Watkins [10a] and

Panas [43] expressed the belief that diffuse meningitis develops so quickly after the ocular symptoms are noted that septic thrombosis of the cavernous sinus is beyond cure by surgical intervention, and even Langworthy,[5] who devised an operation to reach the cavernous sinus surgically, stated that because of the poor accessibility "few men really consider the sinus available for surgical interference, especially when the patient may seem already to be in a septic moribund condition and the cavernous sinus itself only one of a number involved." Chisolm and Watkins [10a] stated that "if the examination of the spinal fluid reveals the presence of a septic meningitis, mere drainage of the cavernous sinus is manifestly inadequate. If, on the other hand, the spinal fluid is clear, the patient has a chance for recovery without operation."

Gaillard [44] also stated the belief that the therapy should be preventive and should consist of vigorous treatment of the original focus. Eagleton [13] recommended three forms of surgical treatment: (*a*) eradication of the original focus, (*b*) the establishment of as free drainage as possible through the original path of the infection and (*c*) placing of the inflamed and thrombosed cavernous sinus at rest by ligation of the common or the internal carotid artery. For the suggestion to tie off the carotid artery in these cases, particularly before any operation is performed on the cavernous sinus, Langworthy [45] gave the credit to Dana C. Drury, who was at that time working as an otologic house surgeon on the staff of the Massachusetts Charitable Eye and Ear Infirmary. Ballance and Hobhouse,[15a] Eagleton [13] and St. Clair Thomson [23] expressed the opinion that if an operation on the cavernous sinus is done it must be performed early, before the disease extends to the opposite sinus and before the meninges become infected. Browder and Myerson [34] went so far as to advocate an attempt to block off the ophthalmic veins at the point of entrance into the cavernous sinus through a temporal approach by the use of electrocoagulation. This they proposed to do and have done before the thrombophlebitis of the ophthalmic veins has reached the sinus, holding that after the thrombosis has involved the sinus any surgical procedure would be useless.

No attempt to operate on the cavernous sinus itself was made until Bircher [21] in 1892 operated on a woman with chronic suppurative otitis media of many years' duration. He used a temporal approach to expose the petrous apex, which was necrotic. The suppuration extended to the posterior portion of the cavernous sinus. The necrotic bone was removed and a gauze drain placed in the posterior end of the cavernous sinus.

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43. Panas, P.: Traité des maladies des yeux, Paris, G. Masson, 1894, p. 379.

44. Gaillard, cited by Langworthy.[1]

45. Langworthy, H. G.: Cavernous Sinus Thrombosis in Children Following Mastoid Inflammation, Laryngoscope **16**:752, 1906.

The patient recovered. About the same time, in 1893, Voss [46] incised the sinus by opening the middle fossa at the level of the great wing of the sphenoid bone, first sawing through the zygomatic arch of the malar bone before doing his osteoplastic operation. This patient died of meningitis. In 1899 Dwight and Germain [11] exposed the sinus by a Krause intradural approach, incised the sinus and inserted a drain. The patient died.

Grünert [47] in 1904, Luc [48] in 1905 and Langworthy [1] in 1907 proposed, with slight variations, a transnasal approach to the sinus.

An approach to the cavernous sinus by way of the orbit was first suggested by St. Clair Thomson,[23] who, for the group of cases of infection of the anterior portion of the sinus, due to thrombosis of the ophthalmic vein, advised the measure suggested by Krönlein, that of temporary resection of the zygomatic border of the orbit to allow removal of the deeper part of the external orbital wall and to permit access to the summit of the orbit. In 1912 Levinger,[49] of Munich, proposed exenteration of the orbital contents and removal of the medial wall after an intranasal approach to the pituitary had been made. In 1913, simultaneously with and independently of Levinger, Mosher [8] proposed the orbital approach to the cavernous sinus, which has since borne his name. After having removed the orbital contents, Mosher then enlarged the sphenoid fissure by cutting away the orbital plate. The sinus was then entered. The patient died. Mosher then elaborated the operative technic by extensive studies on cadavers.

Two patients with thrombosis of the cavernous sinus have recovered following the use of the Mosher technic. One was operated on by Eagleton,[13] who added ligation of the common carotid artery on the side of the lesion, and 1, by Christophe,[50] who visualized a thrombus in the sinus but did not remove it.

In 1935 Browder and Myerson [34] proposed, in the case of an advancing infection which had already invaded the orbit and was destined to involve the anterior portion of the cavernous sinus, to occlude the ophthalmic veins at their point of union with the sinus before thrombosis of the sinus itself has occurred. They performed this operation through an opening in the temporal bone, with intradural elevation of the temporal lobe of the brain, and obliterated the ophthalmic veins at the point

46. Voss, cited by Langworthy.[1]

47. Grünert, cited by Thomsen.[23]

48. Luc, H.: La voie d'accès vers le sinus caverneux, Bull. et mém. Soc. franç. d'otol. et laryng. **21**:178, 1905.

49. Levinger: Zur Operation von Hypophysentumoren und zur Freilegung des Sinus cavernosus, Ztschr. f. Ohrenh. **64**:332, 1912.

50. Christophe, Louis: Thrombo-phlébite du sinus caverneux; opération; guérison, J. de chir. et ann. Soc. belge de chir. **27**:312, 1928.

of union with the cavernous sinus by electrocoagulation. Their patient ultimately recovered with a shrunken blind eye.

The results of operative intervention on the cavernous sinus itself have not been encouraging to date. The only cases in which recovery occurred in which the sinus itself was attacked surgically are those of Bircher, Eagleton, Christophe, and Browder and Myerson. From his own description there is a serious doubt in my mind whether Bircher [21] was dealing with real thrombosis of the cavernous sinus, and, from the description of his operative technic, whether he actually opened the cavernous sinus. In Christophe's [50] case, in which the patient was operated on by the Mosher technic, a thrombus was visualized within the sinus. It was not removed, but a drain was placed in contact with it. No mention was made whether the clot was infected. This patient might also have recovered without the operation on the sinus. The case of Browder and Myerson [34] cannot be considered to be one of thrombosis of the cavernous sinus. If one follows their operative technic in every case in which the patient presents the symptoms which their patient did, one will operate on patients with orbital cellulitis, in many of whom thrombosis of the cavernous sinus would never develop. Furthermore, I am not entirely satisfied that one would not, by the very technic employed, produce an aseptic clot in the sinus in some of the cases.

From the review just given it becomes apparent that surgical intervention on the sinus has been rather disappointing up to the present time and that the statement of Chisolm and Watkins [10a] that the percentage of recoveries is less in patients who are operated on than in those who are not operated on is true. For various reasons this is not to be wondered at. In cases of the acute fulminating type of infection of the anterior portion of the sinus in which the sinus becomes occluded by direct extension of the thrombosis through the afferent vessels, by lodgment of an infected embolism in the sinus or by extension into the sinus of a progressive thrombophlebitic process of these vessels, the condition is hopeless, particularly when both sinuses become involved. The thrombotic process in the sinus is infected from the onset. The dural wall soon breaks down, and the patient dies of the ensuing meningitis. In many of these cases the sinus and the meninges are involved almost simultaneously. To add the effects of an anesthetic and an operative procedure to the load which this moribund patient is already carrying does not, in my opinion, show good judgment. Furthermore, the same results cannot be expected from draining an infection in this sinus that can be obtained from draining a similar focus of infection in the lateral sinus, because the cavernous sinus is a multilocular structure while the lateral sinus is one single blood cavity. Therefore, in this acute fulminating type of cavernous sinus thrombosis I should advise against any operative treatment directed at the sinus itself.

In the other types of thrombosis the picture is not quite so black. In regard to the traumatic type, whether the injury is trauma to the head or injury during an operation, some patients should recover if collateral circulation is reestablished soon enough and if secondary infection does not occur.

In thrombosis of the cavernous sinus which occurs by retrograde action as the result of some focus of infection in the efferent territory of the sinus the thrombus in the sinus itself may, at first, be aseptic. In our work with thrombosis of the lateral sinus my associates and I have sometimes observed cases of retrograde thrombosis extending as far back as the torcular Herophili, cases in which one can never get free bleeding from above, though the focus in the lateral sinus itself may be frankly purulent. Some of these patients get well, and the only acceptable explanation for this is that the thrombosis in the transverse sinus is aseptic. This is a protective mechanism on the part of nature. In the same way the retrograde thrombus in the cavernous sinus itself may be aseptic, even though it may be the result of a septic process elsewhere. Some of these patients may get well if the original focus of infection is vigorously dealt with, and it is in this type of case that Eagleton's proposal to put the sinus at rest by ligation of the carotid artery might be of distinct value. Certainly, in my opinion, it would be folly to disturb the clot in the cavernous sinus itself.

From the preceding observations it becomes apparent that I do not favor surgical intervention on the cavernous sinus in any case of thrombosis of this sinus.

## REPORT OF CASES

Case 1.—Miss L. S., 19 years of age, a patient of Dr. R. Muenzner, complained of earache on the left side for two days; the ear drum ruptured. On the following day she had a temperature of 103 F. and a profuse discharge from the ear. On the next day the temperature dropped to 99 F. She showed improvement daily until one week after the rupture of the drum, when she had a chill and severe headache, especially over the left eye. The mastoid region was very tender, and she was hospitalized. On the day of entrance into the hospital the temperature rose to 104 F., and the pain over the left eye increased in severity.

On the following morning a simple operation on the mastoid was performed. The pus in the mastoid was under considerable pressure. The dura of the middle fossa and the lateral sinus were not exposed.

On the first postoperative day exophthalmos of the left eye was noted. The upper and lower lids were edematous; the bulbar conjunctiva was chemotic, and the movements of the eye were restricted so that partial fixation of the bulb was even then apparent. The cornea was slightly anesthetic; the pupil reacted normally, but the fundus showed engorgement of the retinal vessels. Examination of the blood showed 60 per cent hemoglobin, 3,440,000 red cells and 22,800 white cells.

A diagnosis of thrombosis of the cavernous sinus was made. The wound in the mastoid was reopened, and all the sutures were removed. Hot dressings were

applied. During the next five days the edema of the lids, the chemosis of the bulbar conjunctiva and the exophthalmos increased so that the left eye became completely fixed. Pain and headache were not marked. The temperature was of a septic type, ranging from 99.5 to 104 F.

On the fifth day after the first ocular signs appeared on the left, the right eye began to show evidence of slight edema of the lids and slight proptosis. These symptoms in the right eye subsided in about five days.

Two days after this diplopia was complained of, which persisted for about two weeks, gradually disappearing. The temperature continued to run a septic course until about the sixteenth day, but it dropped gradually during this period so that after the sixteenth day it remained more or less normal. During this period the edema and proptosis of the left eye gradually disappeared. The patient's improvement was gradual but steady, and she left the hospital seven weeks after the operation on the mastoid.

I saw this patient in consultation with Dr. Muenzner on the twelfth day after the ocular symptoms appeared. I have tried to communicate with her since she left the hospital, but without success; so I do not know what her present condition is.

*Comment.*—This was a case of thrombosis of the cavernous sinus of septic origin. The condition appeared after the septic signs of an invasion of the blood stream. The patient may have had thrombophlebitis of the lateral sinus, although this was not confirmed by operation. On the other hand, because of the pain about the left eye she may have had petrositis with direct involvement of the cavernous sinus from the petrous apex. Nevertheless, she made a spontaneous recovery from this condition without any further operative intervention than the simple operation on the mastoid. It is my belief that the thrombosis of the cavernous sinus occurred in a retrograde manner from the lateral sinus or from one of the petrosal sinuses in this case and that the thrombus in the cavernous sinus itself was sterile, for I cannot conceive of recovery taking place in thrombosis of the cavernous sinus when the thrombus within the sinus itself is infected.

Case 2.—Mrs. D. B., aged 61, was seen by me in consultation with Drs. Bolton, Brooks and Rector on Jan. 23, 1934, at Appleton, Wis.

On the evening of Dec. 6, 1933, she was struck by an automobile. She was hospitalized, and a wound in the scalp was cared for. Roentgen examination of her skull revealed a fracture of the petrous portion of the left temporal bone. There was constant bleeding from the left ear, and examination disclosed a ruptured drum.

On December 31 she was discharged from the hospital, but on reaching home it was noted that her right eye did not appear to be normal. The eye was very red; there was profuse tearing, and the upper and lower lids became swollen. There was proptosis of the right eye. This condition became progressively worse, so that when I saw the patient on Jan. 23, 1934, there were marked swelling of both upper and lower lids, chemosis of the bulbar conjunctiva and marked proptosis. There was complete limitation of motion inward and some limitation in other directions. The pupils, the field of vision and the fundi of both eyes were normal. She had not had fever and the leukocyte count was normal. Vision of the

right eye was not involved. No bruit could be made out. On January 9 roentgen examination of both orbital regions was made and showed no fracture in this region.

A diagnosis of aseptic thrombosis of the right cavernous sinus was made.

On February 27 Dr. Bolton reported that the edema of the lids and the proptosis had diminished materially and that the redness of the conjunctiva had improved, though the vision was not as good as before.

By April 9 the edema of the lids and the proptosis were entirely gone, but diplopia had developed in certain portions of the field.

On May 9 all signs of swelling and proptosis were gone. Vision was reported to be good, but diplopia persisted.

I had occasion to examine the patient on June 13. Refraction showed her vision to be normal for distance and for near vision. There was no diplopia. The muscle balance showed 2.5 degrees of exophoria at 6 meters and 8 degrees of exophoria at 33 cm. There was 1.5 degrees of right hypophoria at 6 meters but none at 33 cm. The pupillary reactions were normal. The media and fundi were normal in both eyes. There was a moderate amount of ptosis of the right upper lid. The bulbar conjunctival veins of the right eye were dilated. There was a slight interference with the inward movement of the right eye during convergence. The field of vision was normal.

*Comment.*—This was a case of aseptic thrombosis of the right cavernous sinus. It is interesting that the ocular signs appeared on the right side while the roentgen rays revealed a fracture of the left temporal bone. One must therefore conclude that one of the petrosal sinuses of the right side was also injured at the time of the accident and that the thrombosis reached the cavernous sinus in a retrograde manner. The signs of obstructed orbital circulation did not appear until three weeks after the injury. Therefore, the cavernous sinus was probably not directly injured by the accident, although this is conceivable, for when Cushing accidentally tore open the cavernous sinus during an operation on the gasserian ganglion the proptosis did not occur for four weeks.

Case 3.—Mrs. H. L., aged 40, was seen by me in consultation with Dr. Garvey and Dr. Elconin on Feb. 14, 1936.

The patient was injured on New Year's eve, 1936, in an automobile accident. She struck the left temporal region of her head against the door-frame of the automobile. She was not rendered unconscious. That night she noted a pounding sensation on the left side of the head and in the left ear. This sensation was synchronous with the pulse beat. On the following day the pounding noise suddenly became more intensified, and it had continued so ever since. In the three or four weeks following injury, she had three or four sensory jacksonian attacks of numbness in the right arm, and on one of these occasions there was aphasia. She had had several minor attacks of weakness in the right arm.

On entrance into the hospital, about four weeks after her accident, it was noted that the pupils were equal and exhibited normal reactions. There were a slight weakness of the external rectus muscle on the left and diplopia in the left portion of the field. Dilatation of the left temporal vein and slight ptosis of the left upper lid were present. Examination of the fundus gave negative results except for some venous pulsation in the veins of the right eye. There was some proptosis of the left eye but no pulsation of the globe.

A loud bruit was heard over the left eye and all the left side of the head, which was transmitted to the left carotid artery. Pressure over the left carotid artery at the region of the bifurcation caused the bruit to cease both subjectively and objectively.

Roentgenograms of the skull, taken on February 11, revealed no evidence of fracture of the skull and no abnormality of the petrous pyramids or of the sella turcica.

On February 14 my own examination corroborated the aforementioned findings of Dr. Garvey, except that on this date the proptosis had receded, and no venous pulsation in the fundus could be made out.

On March 6 I found some increased swelling of both the upper and the lower lid of the left eye. There was again slight proptosis. Movements of the bulb were not restricted. There was no diplopia in any portion of the field. There was some injection of the veins of the left bulbar conjunctiva. The pupillary reactions were normal. There was more engorgement of the veins of the left fundus than of those on the right. No venous pulsation was present, and no pulsation of the eyeball was noted. There was an enlarged vein on the right side of the nose near the inner canthus. The noise in the left ear was synchronous with the pulse rate, and the bruit remained unabated.

A diagnosis of traumatic arteriovenous communication between the carotid artery and the cavernous sinus was made.

Digital compression of the left carotid artery at the bifurcation, made at various times, was not well borne and soon caused numbness and coldness of the right hand. For this reason I have suggested that some sort of a metal band or clamp be devised which could be placed around the carotid artery and gradually closed over a period of several weeks. Up to the present time this has not been done.

*Comment.*—Although this was not, strictly speaking, a case of thrombosis of the cavernous sinus, the condition should be classed among the aseptic types of this condition. Although the signs of obstruction of the orbital circulation have been minimal and transitory to date, they will probably become complete before or after the carotid artery is ligated. The close sequence between the accident sustained and the appearance of the subjective noise on the left side of the head, synchronous with the pulse rate, associated with a systolic bruit which can be entirely cut off both objectively and subjectively by compression of the left carotid artery, indicates that this patient has suffered from an arteriovenous communication within the cavernous sinus on the left side. The prognosis must be somewhat guarded, although the mortality from ligating the carotid artery in these cases is less than 20 per cent.

Case 4.—E. P. A., a man aged 46, was seen first at home on June 22, 1935. His illness began about June 17, with a severe attack of grip, the temperature rising to 103 and 104 F.

The patient complained of severe pain in the left supra-orbital region and over the left side of the nose. He had marked malaise.

This patient has been under my observation since February 1921. He had at that time a definite allergic nasal condition. In October polyps were removed from the region of the duct between the right frontal sinus and the nasal meatus.

In March 1926 Dr. George Shambaugh did a conservative intranasal operation on the ethmoid bone on the right side. In October 1926 I reoperated on the area of the right ethmoid sinus, removing a portion of the middle turbinate bone on the right. In March 1927 a simple operation on the mastoid was done on the right side. In November a submucous resection of the septum was done, and at the same time a window resection of the right naso-antral wall was performed.

The patient was hospitalized. There was marked tenderness over the left frontal area and the left maxillary area. Pus was pouring from the left middle meatus. On the patient's entrance to the hospital the temperature was 103.4 F. The white cell count of the blood was 18,100, and the differential count showed 82 per cent polymorphonuclear cells. The urine was normal.

On June 24, 1935, there was considerable swelling of the left upper lid, but no proptosis and no diplopia or restriction of ocular movements. The pupils were equal and reacted to light. Roentgen examination showed evidence of old inflammatory changes in all the sinuses on the right side. Roentgenograms showed rather indefinite evidence of changes in the sinuses on the left side, though there was a suggestion of increased density in the middle of the left frontal sinus.

On June 25 edema of the left eyelids was more marked, and some chemosis was present. There was some downward proptosis of the left eye, and limitation of outward movement of the left eye was noted. The left fundus showed marked engorgement of veins and considerable edema about the disk. Double vision was present.

On June 26 there was considerable improvement in all the signs noted the day before. The temperature had reached normal by this time.

On July 2, under treatment with hot compresses applied to the left eye and to the forehead and repeated blood transfusions, the general condition of the patient improved. The swelling about the left eye gradually diminished, and the proptosis receded until there was only one small point of swelling at the inner end of the left upper lid.

On July 11 the swelling of the left eyelids increased considerably, and the left eye again showed proptosis downward and outward.

An external operation was done, the floor of the left frontal sinus being removed. The sinus was filled with pus. The anterior ethmoid cells were broken into and were found to be filled with pus. While the paper plate was being bitten away a large necrotic portion of it came away, and at the same time pus appeared from the orbit in this neighborhood. The orbital abscess was explored with the Kelley forceps. The duct between the right frontal sinus and the nasal meatus was enlarged; a rubber tube drain was passed into the nose, and the external wound was closed by sutures.

On July 15 the patient showed improvement. Most of the swelling about the left eye and the proptosis were gone.

On July 20 the wound was healed. The left eye was normal. The tube drain had been removed several days previously, and the patient was discharged from the hospital.

On August 26 refraction showed vision of each eye to be 20/15 for distance and 14/14 for a near point. There was no diplopia; muscle balance was good, and the fundi of both eyes were normal.

*Comment.*—This was not a case of thrombosis of the cavernous sinus. The report is introduced here to indicate the difficulties of differential diagnosis. At one time during the course a tentative diagnosis

of thrombosis of the cavernous sinus was made. The diagnosis of orbital abscess is definite and was proved at operation. The cavernous sinus may have been involved, but the fact that the second eye did not become affected and particularly the fact that the patient recovered from an anterior fulminating infection would lead me to conclude that the cavernous sinus had not been infected.

## CONCLUSIONS

There are septic and aseptic types of thrombosis of the cavernous sinus. The aseptic types are caused by penetrating injuries involving the sinus, by accidental injury to the sinus during an operation in its neighborhood and by fracture of the skull and injury to the head. In this group must also be included the marasmic types of thrombosis.

In the septic types in which the thrombosis or thrombophlebitis reaches the cavernous sinus by way of its afferent vessels the mortality is practically 100 per cent.

In those cases in which the condition is septic and of the restrained or chronic compensatory type, in which the thrombotic process reaches the cavernous sinus by retrograde action along its efferent vessels, there is some hope of recovery. In the cases of this group in which recovery occurred the thrombotic process in the cavernous sinus itself must have been aseptic, although originating from a septic source elsewhere.

The percentage of recovery from all types of thrombosis of the cavernous sinus is probably not greater than 7 per cent. The percentage of recovery from the purely aseptic types is considerably higher than this.

Operations on the cavernous sinus have been extremely disappointing and have shown poorer results than nonoperative treatment. When the thrombosis originates from a septic source the focus should be vigorously treated and eradicated. The cavernous sinus itself should be let alone. As an exception to this general statement, it would seem that ligation of the carotid artery, as proposed by Eagleton, might prove beneficial.

# EFFECTS OF BACTERIAL TOXINS IN THE MIDDLE EAR

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Infections of the middle ear give rise to pain, fever, general malaise and various degrees of temporary deafness. The destructive processes of bacteria produce necrosis of bony and soft tissues, and the repair is marked by deposits of fibrous tissue. The possibility that toxins in the middle ear effect changes in the endings of the auditory and vestibular nerves has been given little consideration. It has been shown [1] that procaine hydrochloride, quinine, alcohol and hydrochloric acid are capable of passing from the middle ear to the endings of the vestibular nerve and there producing functional changes. It is probable that bacterial toxins in the middle ear would penetrate also to the endings of the eighth nerve. It is possible that the toxins of certain bacteria are capable of destroying the function of endings of this same nerve. Therefore, it was decided to make observations on the effects of a number of bacterial toxins placed in the middle ear. Various observations were made on the vestibular and auditory functions.

## EXPERIMENTAL WORK

Dogs were used as subjects. Toxins of staphylococci, pneumococci and hemolytic streptococci and of the organisms of scarlet fever, tetanus and diphtheria were injected into the middle ear. Observations were made on gait, position, nystagmus and responses to rotation and to caloric and hearing tests.

The dogs were anesthetized with ether. The toxic preparation was inserted through the drum with a syringe needle. The solution was kept in the middle ear half an hour while anesthesia was maintained.

The toxins of staphylococci, pneumococci and hemolytic streptococci were prepared by Dr. Isaac Kendall of the department of bacteriology. Cultures of material from patients with acute infections were grown in meat infusion. These were incubated for forty-eight hours. The filtrate obtained by means of the Berkefeld filter was used as the toxin in each case. The toxins of scarlet fever, tetanus and diphtheria were obtained from Parke, Davis & Co. The scarlet fever

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1. Ross, E. L., and Rawson, R. W.: Absorption of Middle Ear, Arch. Otolaryng. **22**:312 (Sept.) 1935.

toxin contained 4,000 skin test doses per cubic centimeter. The minimum lethal dose of the tetanus toxin was 0.00025 cc., while that of the diphtheria toxin was 0.0042 cc.

The animal was attached with its belly and chin down on a horizontal board which was rotated by a motor. The rotation, which was in a horizontal plane, was continued for thirty turns and then suddenly stopped. The duration of nystagmus was measured with a stop-watch.

TABLE 1.—*Effect of Toxins on Nsytagmus Resulting from Rotation* *

| | | Before Injection | | After Injection of Right Ear | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Same Day | | 2-3 Days | | 4-5 Days | | 6-7 Days | |
| | | Rotation | | Rotation | | Rotation | | Rotation | |
| Toxin | Dog | Right | Left | Right | Left | Right | Left | Right | Left |
| Hemolyticus str. | 1 | 16.6 | 22.0 | 17.8 | 22.8 | 17.4 | 21.4 | 17.6 | 22.4 |
| | 2 | 21.7 | 21.6 | 20.6 | 21.2 | 22.6 | 23.2 | 20.4 | 21.8 |
| | 3 | 24.4 | 22.5 | 20.8 | 18.8 | 19.2 | 19.9 | 18.3 | 18.0 |
| | Average | 20.9 | 22.0 | 19.7 | 20.9 | 19.7 | 21.5 | 18.8 | 20.9 |
| Staph. | 1 | 19.2 | 18.4 | 17.8 | 19.6 | 18.6 | 20.2 | 20.4 | 19.4 |
| | 2 | 12.1 | 14.2 | 13.5 | 14.8 | 12.8 | 13.8 | 12.4 | 13.6 |
| | 3 | 23.5 | 21.2 | 23.8 | 22.4 | 20.8 | 18.6 | 21.4 | 22.6 |
| | Average | 18.9 | 17.6 | 19.1 | 16.9 | 18.5 | 17.3 | 18.4 | 17.5 |
| Pneumococcus | 1 | 14.2 | 13.6 | 13.8 | 13.6 | 14.0 | 13.2 | 13.6 | 13.4 |
| | 2 | 23.6 | 24.8 | 22.5 | 23.8 | 23.0 | 24.4 | 21.8 | 20.6 |
| | 3 | 18.6 | 17.2 | 19.2 | 17.6 | 18.4 | 17.0 | 18.0 | 16.8 |
| | Average | 18.5 | 18.5 | 18.5 | 18.3 | 18.5 | 18.2 | 17.8 | 16.9 |
| Scarlet fever | 1 | 21.9 | 22.7 | 22.1 | 20.6 | 21.8 | 18.6 | 19.1 | 13.8 |
| | 2 | 21.2 | 22.6 | 23.2 | 21.8 | 20.1 | 20.0 | 25.9 | 17.9 |
| | 3 | 21.8 | 21.0 | 23.0 | 20.2 | 21.1 | 20.6 | 21.8 | 21.3 |
| | 4 | 11.2 | 11.4 | 17.4 | 9.8 | 17.4 | 10.7 | 16.1 | 10.5 |
| | Average | 19.0 | 19.4 | 21.4 | 18.1 | 21.1 | 17.5 | 20.7 | 15.9 |
| Tetanus | 1 | 16.6 | 16.2 | 16.0 | 16.2 | 16.6 | 15.8 | 16.8 | 15.8 |
| | 2 | 18.2 | 18.4 | 15.8 | 15.0 | 14.0 | 14.2 | 14.4 | 14.0 |
| | 3 | 23.4 | 21.6 | 22.6 | 21.8 | 23.2 | 22.4 | 21.4 | 20.2 |
| | 4 | 20.4 | 19.2 | 19.8 | 19.6 | 20.2 | 20.8 | 20.6 | 19.4 |
| | Average | 19.8 | 18.8 | 18.5 | 18.1 | 18.5 | 18.0 | 18.3 | 17.3 |
| Diphtheria† | 1 | 29.6 | 27.1 | 32.4 | 18.6 | 31.8 | 16.5 | 30.2 | 12.6 |
| | 2 | 26.2 | 30.6 | 29.8 | 17.4 | 29.3 | 15.8 | 28.6 | 10.8 |
| | 3 | 15.9 | 17.2 | 17.7 | 13.6 | 20.5 | 10.9 | 17.7 | 6.9 |
| | 4 | 13.3 | 12.7 | 21.3 | 9.7 | 17.1 | 6.0 | Dead | .... |
| | 5 | 15.2 | 17.1 | 20.3 | 17.0 | 18.1 | 13.6 | 17.7 | 9.8 |
| | 6 | 18.4 | 17.8 | 19.2 | 14.6 | 18.2 | 12.2 | 17.8 | 10.5 |
| | 7 | 16.6 | 16.2 | 17.8 | 12.4 | 19.6 | 11.6 | 18.4 | 9.3 |
| | 8 | 21.8 | 22.0 | 28.8 | 16.1 | Dead | .... | .... | .... |
| | 9 | 23.2 | 24.8 | 22.8 | 13.3 | 22.8 | 6.1 | 21.6 | 5.2 |
| | Average | 20.0 | 20.6 | 23.3 | 14.7 | 22.2 | 11.6 | 21.7 | 9.3 |

* The results are expressed in seconds of nystagmus.

† All dogs in this group had spontaneous nystagmus to the left of varying degrees in from four to six days. In dogs 6, 7 and 9 the caloric tests of the right ear did not produce nystagmus and that of the left ear produced marked nystagmus. The others were not tested.

The caloric test was made on the animal with the head in the supine position. Very cold water, approximately 13 C., flowed directly on the drum through a small catheter inserted into the canal as far as the drum. If no nystagmus developed after 5 or 6 ounces (150 or 160 cc.) of water was run over the drum, the vestibular nerve was pronounced dead.

Several animals were roughly "conditioned" for hearing. They were fed each morning by the same person in one of two rooms which were on opposite sides

of a hall. A dog was held at the end of the hall and was called by the feeding attendant. Evidence of hearing was shown by the animal looking in the direction of the call and jerking to go. The call was repeated three times. Then the animal was allowed to go for his food. Failure to respond was valued at 15 per cent. Failure to go in the right direction to find the food was valued at 50 per cent.

## RESULTS

The results given in table 1 show the duration of nystagmus resulting from a standard horizontal rotation at intervals of from one to two days for a week after the injection of a toxin into the right middle ear. In the dogs in which the toxins of hemolytic streptococci, staphylococci (Staphylococcus aureus) and pneumococci and of the organism of tetanus were used there was no significant change at any time. The effects might have been different if stronger preparations had been used or observations had been continued over a longer period of time, but the results do not suggest it.

The toxin of scarlet fever reduced the reaction slightly in 3 of 4 animals. The averages for the group lead to the same conclusion.

The toxin of diphtheria produced a decided effect. In every one of the 9 animals there was a marked reduction in the reaction when the dog was rotated to the left. The average of the last observations showed less than half as much response when the dog was turned to the left as when it was turned to the right. Such a result is obtained when the right ear is destroyed. Every dog displayed unmistakable nystagmus to the left at some time during the week. This alone was sufficient for the conclusion that the toxin had depressed the vestibular function of the right ear. The caloric tests on animals 6, 7 and 9 indicated that the vestibular function of the right ear had been completely destroyed.

Since the toxin of diphtheria had been so destructive to the vestibular division of the eighth nerve it was thought that possibly it had affected the auditory nerve also. Table 2 contains the observations on the hearing of 5 dogs. In dog 2, which died during the injection into the second ear, there was positive evidence of considerable loss of hearing. All of the other 4 dogs failed to respond to calls or to loud noises within 2 feet (60 cm.) of them. These animals were apparently perfectly deaf at the end of a week. Their movements and attitude indicated that both vestibular organs were functionless. In dogs 4 and 5 this was proved by the lack of any reaction to the caloric tests.

## REVIEW OF THE LITERATURE

We have been unable to find any record of bacterial toxins being injected into the middle ear. The closest resemblance to the condition

TABLE 2.—*Effects of Diphtheria Toxin on Hearing of Five Dogs*

| Date | Response, Percentage | Comment |
|---|---|---|
| | | **Dog 1—Brown Spitz** |
| March 11 | 85 | |
| March 12 | 100 | |
| March 13 | 85 | |
| March 14 | 100 | |
| March 15 | 85 | |
| March 16 | 100 | |
| | | The injection was made into the right middle ear through the tympanic membrane while the animal was under ether anesthesia. About 1.5 cc. of diphtheria toxin was injected |
| March 18 | 50 | On being released the animal found the caller by trial and error. His sense of direction seemed to be impaired |
| | | Diphtheria toxin was injected into the left middle ear |
| March 19 | 50 | The dog responded to the call but was unable to find the caller |
| March 20 | 16 | Only once did the animal appear to hear the call |
| March 21 | 0 | The animal made no response or attempt to find the caller |
| March 22 | 0 | The animal made no response. At the banging of a door within 1 foot (32 cm.) of the dog's head, the animal showed no signs of hearing. There was not even a blink of the animal's eye |
| | | The animal stands on a wide base, is ataxic and exhibits parkinsonian-like movements of the head |
| | | **Dog. 2—Blackey** |
| March 10 | 100 | |
| March 11 | 100 | |
| March 12 | 85 | |
| March 13 | 100 | |
| March 14 | 100 | |
| March 15 | 100 | |
| March 16 | 100 | |
| March 17 | 100 | |
| | | Diphtheria toxin was injected into the right ear while the animal was under ether anesthesia |
| March 18 | 50 | The dog had no sense of direction |
| | | The animal died while the injection was being made into the left ear |
| | | **Dog 3—Whitefoot** |
| March 10 | 100 | |
| March 11 | 100 | |
| March 12 | 85 | |
| March 13 | 85 | |
| March 14 | 100 | |
| March 15 | 100 | |
| March 16 | 85 | |
| March 17 | 100 | |
| | | Diphtheria toxin was injected into the right middle ear while the dog was under ether anesthesia |
| March 18 | 50 | The dog was unable to find the caller until after several trials |
| March 19 | 50 | |
| March 20 | 15 | |
| March 21 | 15 | |
| March 22 | 0 | |
| March 23 | 0 | Banging on a door within 12 inches of the dog's head caused no response |
| | | **Dog 4*—Whitey** |
| March 30 | 85 | |
| March 31 | 100 | |
| April 1 | 100 | |
| April 2 | 85 | |
| April 3 | 100 | |
| | | Diphtheria toxin was injected into both middle ears |
| April 4 | 33 | The dog started twice on being called but was unable to find the caller |
| April 5 | 16 | |
| April 6 | 0 | |
| April 7 | 0 | Firecrackers were exploded within 18 inches (45 cm.) of the animal's ear but were so concealed that the animal could not see the flash. The animal showed no response to three tests. The animal was very ataxic, falling in either direction on walking. A caloric test in both ears with water at 13 C. produced no nystagmus |
| | | **Dog 5*—Whitefoot** |
| March 30 | 100 | |
| March 31 | 85 | |
| April 1 | 100 | |
| April 2 | 100 | |
| April 3 | 100 | Diphtheria toxin was injected into both middle ears |
| April 4 | 33 | |
| April 5 | 16 | |
| April 6 | 0 | |
| April 7 | 0 | The dog appeared not to hear the report of firecrackers fired within 10 inches of the ear. There was not even the blink of an eye. The animal was very ataxic. A caloric test in both ears with water at 13 C. produced no response |

* The caloric tests on dogs 4 and 5 showed that both vestibular organs were not functioning.

produced by this experimental procedure that has been recorded in the literature is found in reports on various infections of the middle ear.

Yearsley [2] reviewed 4,000 cases of deafness. In 20 per cent the condition was due to exanthemas and infective diseases, mostly scarlet fever, measles and diphtheria. He states that diphtheria was a cause of catarrhal disease of the inner ear and of suppurative disease of the middle ear.

Seiferth [3] reported 2 cases of scarlet fever in which there was loss of hearing and of vestibular functions in both ears. He stated that the process was very necrotic.

Williams [4] reviewed 899 cases of otitis media associated with scarlet fever; and in every case in which deafness was recorded there was also reference to necrosis of the middle ear.

Panneton [5] reported a case of diphtheria of the external auditory canal but did not mention any resulting deafness.

Davidsohn and Heck [6] examined the discharge from the ear in 91 cases of otitis media in infants and found diphtheria bacilli in 30.8 per cent.

Preidt [7] reported the presence of diphtheria bacilli in the discharge from the ear in 28 per cent of a series of 71 cases of otitis media. He made no mention of deafness in these cases.

Bergh [8] reported 121 cases of acute otitis media which occurred as a complication of diphtheria. He did not state the incidence of deafness and vertigo.

Arslan-Kardiache [9] reported the development of neuritis of the auditory nerve following diphtheritic angina. Hearing was greatly diminished in the left ear, and there was practically no reaction to the caloric tests.

Shemeley [10] stated that of the 12 cranial nerves there are 2, the optic and the auditory nerve, which seem to be peculiarly susceptible to toxins. He claimed that the toxins of diphtheria, the various exanthemas and infectious diseases are capable of producing neurolabyrinthitis of the eighth nerve. He described 2 cases.

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2. Yearsley, M.: Brit. J. Child. Dis. **31**:177, 1934.
3. Seiferth, L. B.: Beitr. z. Anat., Physiol. path. u. Therap. d. Ohres. **29**:210 (Nov.) 1931.
4. Williams, H. J.: Ann. Otol., Rhin. & Laryng. **44**:110, 1935.
5. Panneton, P.: Laryngoscope **43**:463, 1933.
6. Davidsohn, H., and Heck, H.: Berl. klin. Wchnschr. **58**:1040, 1921.
7. Preidt, H.: Ztschr. f. Kinderh. **53**:304, 1932.
8. Bergh, E.: Monatschr. f. Ohrenh. **68**:1, 1934.
9. Arslan-Kardiache: Rev. de laryng. **53**:935, 1932.
10. Shemeley, W. G.: Laryngoscope **35**:436, 1925.

Shambaugh [11] discussed the importance of focal infection in producing primary labyrinthitis in 4 cases.

Mackenzie [12] also claimed that focal infection was the cause of neurolabyrinthitis and presented a case of this type. He stated "that the secondary toxins generated in the primary blood stream produced no ill effects except in the organ or tissue for which the toxin showed a selective action."

Later Mackenzie [13] presented a case of neurolabyrinthitis which was due to focal infection about a tooth.

Cutter [14] reported a case of deafness developing in a boy who had received tetanus antitoxin a week before and who at the time had diplopia, rigidity of the neck and some mental cloudiness. One ear recovered almost completely, but the other retained only approximately 20 per cent of normal hearing.

Benesi and Sommer [15] discussed all of the causes of toxic neuritis of the ear and classified the toxins as exogenous and endogenous. Under the endogenous toxins, they discussed and cited references in the literature to infections which have been associated with or complicated by neuritis of the eighth nerve. All of these were infections which were not associated with disease of the middle ear. The infectious diseases referred to by them as being associated with neuritis of the eighth nerve included scarlet fever, diphtheria, measles, variola, epidemic meningitis, parotitis, influenza, dysentery, typhus, typhoid, encephalitis, erysipelas, gonorrhea, pertussis, pneumonia, acute rheumatism, malaria and focal infections. The authors reviewed the work of previous investigators and obtained the following information: Bezold reported 7 cases of deafness following scarlet fever without any signs of disease of the middle ear. Burkhard-Merian observed 3 cases of complete deafness with intact drums after recovery from scarlet fever. Knapp, Wittmaack and Voss reported a case of deafness following an attack of scarlet fever without any signs of an infection of the middle ear. Bezold presented the report of a case of complete deafness following diphtheria without any evidence of disease of the middle ear. Elman reported a case in which, three weeks after an attack of diphtheria, complete deafness developed with a disturbance of equilibrium and paralysis of the glossopharyngeal nerve as well as of the seventh nerve. Kretschman

11. Shambaugh, G. E.: Ann. Otol., Rhin. & Laryng. **26**:687, 1917.

12. Mackenzie, G. W.: Laryngoscope **39**:282, 1929.

13. Mackenzie, G. W.: Laryngoscope **39**:878, 1929.

14. Cutter, R. D.: Auditory Nerve Involvement After Tetanus Antitoxin: First Reported Case, J. A. M. A. **106**:1006 (March 21) 1936.

15. Benesi, O., and Sommer, J., in Alexander, G., and Marburg, O.: Handbuch der Neurologie des Ohres, Berlin, Urban & Schwarzenberg, 1923, vol. 2, pt. 2, p. 788.

observed a 14 year old boy with a loss of hearing followed by vertigo, both of which improved after the injections of pilocarpine hydrochloride. Grahe noted a case of diphtheria in which loss of hearing was associated with a marked shortening of the bone conduction time. Haug saw a 12 year old girl who became deaf in both ears after recovery from diphtheria, but who, after electrical stimulation and injections of pilocarpine hydrochloride could again hear a loud voice. Moos made histologic studies of the ears of children who had died of diphtheria and found thrombi in the inner canal, hemorrhages in the auditory nerve, degeneration of the nerve, atrophy and complete degeneration of the nerve fibers and ganglion cells in the labyrinth. Leven made observations similar to those made by Moos. Rohrer described a case in which sudden deafness developed eight days after the beginning of the eruption of scarlet fever and hearing returned after twenty-five days. Moos observed 2 cases of total deafness with vertigo which occurred after an attack of measles. Others reporting the occurrence of deafness following measles were Knapp, Blau, Buehner, Schwartze, Lucae, Zaufal, Bezold and Kieselbach. Hirsch reported an isolated instance of vestibular neuritis after immunization to typhus. Beck injected various bacterial toxins intravenously into rabbits and guinea-pigs and found in some of them changes in the region of the hearing organ and the hearing centers. After the injection of staphylococcus toxin he observed paralysis of the nerve fibers and ganglion cells. Histologically, he found a disappearance of Deiters' supporting cells and sensory cells in the organ of Corti. After administering typhus toxin he observed degenerative changes in the myelin sheaths of the nerve fibers with swelling of the sensory cells in the organ of Corti. After the administration of diphtheria toxin there appeared changes in the organ of Corti. This was sunken with the cortical membrane adherent, but the sensory cells had not undergone shrinkage. Alagna found changes in the cochlear ganglion after the injection of diphtheria toxins into animals.

The attempt to harmonize our experimental results with clinical observations is rather difficult. The essentials of our experimental conditions were: (1) normal middle ears and (2) a high concentration of toxin which was kept in the middle ear for only half an hour. In cases of otitis media the middle ear is swollen and hyperemic, and there may be granulation, exudation and pus. Each of these factors reduces absorption. Hyperemia lessens the depth of the penetration of the toxin and weakens the concentration of it in the tissues. Proof of this lies in the fact that alcohol and several other common therapeutic agents applied to the middle ear in cases of otitis media do not produce vertigo as they do when put into the normal middle ear of dogs. However, in cases of otitis media the toxins of the organism are constantly present for an average of about ten days and therefore result in a much greater absorption.

In view of the recent work, it seems safe to conclude that the approximately normal middle ear may carry any toxin in it to the endings of the eighth nerve. Is the approximately normal middle ear always free from all aerobic and anaerobic bacteria? In view of the observations of Davidsohn and Heck [6] and Preidt [7] on the frequency of diphtheria bacilli in discharges from the middle ear and of Berg [8] on the cases of otitis media complicating diphtheria and of the observations herewith reported on the effect of diphtheria on the functions of the inner ear, a thorough search for bacteria is indicated. This is particularly so for anaerobic bacteria in the middle ears of persons suffering from progressive deafness and vertigo. If anaerobic bacteria were responsible, the condition would be improved, at least temporarily, by inflation and aeration of the eustachian tubes.

## SUMMARY AND CONCLUSION

Toxins of hemolytic streptococci, staphylococci (Staph. aureus) and pneumococci and of the organisms of scarlet fever, tetanus and diphtheria were injected into the middle ears of dogs. Observations were made on the vestibular and hearing functions.

The toxins of hemolytic streptococci, staphylococci (Staph. aureus), pneumococci and of the organisms of tetanus had no effect on the vestibular functions. The toxin of scarlet fever reduced the reaction to rotation slightly.

The toxin of diphtheria destroyed the vestibular function and hearing.

# MOCCASIN SNAKE (ANCISTRODON PISCIVORUS) VENOM THERAPY FOR RECURRENT EPISTAXIS

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This clinical study illustrates the beneficial effect of moccasin snake venom in the treatment of recurrent epistaxis.

In 1930 Peck and Sobotka [1] showed that rabbits could be made refractory to the Shwartzman phenomenon (an experimental purpura produced by the intradermal injection of bacterial toxic filtrates followed after a suitable interval by an intravenous injection) [2] by previous injections of moccasin snake venom. Since no circulating antibodies could be demonstrated to explain the refractory state produced and since potent antivenin had no effect on the course of the Shwartzman phenomenon, it was concluded that the refractory state was most likely elicited by the action of the venom on the capillaries.

A number of snake venoms were used in these experiments. It was found that bothrops and rattlesnake venom did not produce the refractory state to the Shwartzman phenomenon. The venom of the copperhead, on the other hand, showed evidence of possessing refractivity-producing factors, but moccasin snake venom proved to be the most effective in creating the refractory state. It is interesting that the venoms from different moccasin snakes varied in their content of refractivity-producing factors. Even several of the moccasin venoms were not capable of producing a refractory state. To determine the therapeutic value of the different moccasin venoms, a method for the titration of the refractivity-producing factors has been suggested.[3]

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From the Department of Laryngology and Laboratories of the Mount Sinai Hospital.

1. Peck, S. M., and Sobotka, H.: Production of a Refractory State as Concerns the Shwartzman Phenomenon by the Injections of Venom of the Moccasin Snake (Ancistrodon Piscivorus), J. Exper. Med. **54**:407 (Sept.) 1931.

2. Shwartzman, Gregory: Studies in Bacillus Typhosus Toxic Substances: I. Phenomenon of Local Skin Reactivity to B. Typhosus Culture Filtrate, J. Exper. Med. **48**:247 (Dec.) 1928.

3. Peck, S. M.: A Refractory State as Concerns the Shwartzman Phenomenon: Observations on Potency of Individual Venoms, J. Immunol. **25**:447 (Nov.) 1933.

In the last few years a large series of patients with various hemorrhagic conditions have been treated by injections of moccasin snake venom.[4] The most favorable results were obtained in those with the so-called functional bleeding abnormalities (functional uterine bleeding, idiopathic nasal bleeding, etc.) which were not associated with any blood dyscrasia.

In previous reports [5] relatively few cases of recurrent nasal bleeding have been mentioned in which injections of moccasin venom were used. However, the results in the cases in which it was used were encouraging enough to warrant further trial of this therapy in a larger series of cases. This report embodies the results of clinical experiences over a period of two years with a group of forty-two patients. Many of them have been observed for over a year. The blood pictures of all these patients were within normal limits, indicating that the condition was entirely local.

## TREATMENT

All the patients were treated by subcutaneous injections of moccasin venom prepared in the laboratories of the Mount Sinai Hospital. The venom was obtained through the courtesy of Dr. R. L. Ditmars, curator of reptiles of the Bronx Zoological Gardens. The venom was diluted to 1:3,000 with an 0.85 per cent saline solution and preserved with a 1:10,000 dilution of sodium merthiolate.[6]

*Dosage.*—The initial dose was 0.5 cc. of the 1:3,000 dilution. Subsequent injections were rapidly increased to 1 cc. as a maximum dose. For children the initial dose was 0.3 cc., 0.8 cc. being the maximum amount. In a number of the patients hypersensitivity to the venom protein became manifest after the fourth or fifth injection.

The patients in this series were given injections twice a week for variable periods, depending on the symptoms. In instances in which the epistaxis was readily controlled, from four to eight injections constituted a course of treatment. If the nasal bleeding was not entirely controlled after this period, two injections a week were continued until the clinical result warranted cessation of the treatment. Some of the patients in the group with telangiectasia required a maintenance dose every one or two weeks for satisfactory control of the epistaxis Two such patients have been receiving treatment for over a year. There is no

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4. (*a*) Peck, S. M.: Attempts at Treatment of Hemorrhagic Diatheses by Injection of Snake Venom, Proc. Soc. Exper. Biol. & Med. **29**:579 (Feb.) 1932. (*b*) Peck, S. M., and Goldberger, M. A.: The Treatment of Uterine Bleeding with Snake Venom, Am. J. Obst. & Gynec. **25**:887 (June) 1933. (*c*) Peck, S. M., and Rosenthal, N.: Effect of Moccasin Snake Venom in Hemorrhagic Conditions, J. A. M. A. **104**:1066 (March 30) 1935.

5. Peck.[4a] Peck and Rosenthal.[4c]

6. Moccasion snake venom similarly prepared can now be obtained for professional use from the Lederle Laboratories, Inc.

contraindication for more frequent injections of the venom when this is desirable. Daily injections of 1 cc. have been given for three months by Peck[7] with no untoward effect.

*Reaction.*—The reaction in all the cases in which hypersensitivity was evidenced was confined to the local area of injection. Systemic symptoms and fever and even regional adenopathy were not encountered. The local reaction usually consisted of swollen, red, painful areas varying in size from several centimeters to the entire side of the arm. These phenomena usually occurred within twenty-four hours after the injection and subsided quickly with wet dressings. In a few instances the patients complained of lack of power in the arm for a day or two.

The foregoing manifestations of hypersensitivity appeared in eighteen cases. It was slight in five instances, moderate in ten and severe in three. All the patients who showed hypersensitivity were successfully desensitized with the following rapid technic. Beginning with 0.1 cc. of a 1:3,000 dilution of venom, successive doses were increased by 0.1 cc. until 0.6 cc. was reached and then by 0.2 cc. until 1 cc. was reached. Then the maximum dose of 1 cc. was resumed.[8]

## CLINICAL STUDY

Forty of the patients were treated in the outpatient clinic of the department of laryngology of the Mount Sinai Hospital. The remaining two were physicians on the hospital staff.[9] All the patients who had a history of repeated epistaxis were treated according to the method outlined. Many of these patients manifested bleeding points, evidences of sinusitis or nasal obstruction, but no treatment was administered to affect these conditions during the period of observation. In other words, other factors which might influence the nasal bleeding were not altered, so that the snake venom could be properly evaluated. It should be mentioned that a large number of these patients gave a history of previous cauterization, usually on several occasions. Two of the patients had also been treated with radium.

On analyzing these cases it was found that the patients could be grouped according to the source of bleeding. The following classification was formulated: (1) telangiectasia of the nasal septum, (2) ulcerations of the nasal septum, (3) bleeding without a visible source and (4) hemangioma of the nasal septum.

*Telangiectasia of the Nasal Septum.*—In every case prominent vessels were noted on the membrane of the nasal septum. The telangiectasia varied from several dilated vessels on one side of the septum to extensive involvement of both sides. The latter type was regarded as closely related to multiple hereditary telangiectasia (Osler's disease).

There were thirteen patients in this group. Eleven were less than 30 years of age. Seven were females, and six were males. The duration of the epistaxis in

7. Peck, S. M.: Personal communication to the author.

8. Peck, S. M.: Sensitization and Desensitization in Man with Snake Venom (Ancistrodon Piscivorus), Arch. Dermat. & Syph. **27**:312 (Feb.) 1933.

9. Dack, Simon: Treatment of Intractable Nasal Hemorrhage by Injections of Moccasin Snake Venom, J. A. M. A. **105**:412 (Aug. 10) 1935.

these patients was as follows: Two bled for twenty years; four, from five to ten years; five, from two to five years, and two, less than one year. The frequency of epistaxis varied from daily recurrences to several times during the month.

In eight cases the epistaxis was entirely arrested after from one to three injections of the snake venom. In two cases about six injections were necessary before the nasal bleeding was controlled. In the remaining three cases the epistaxis was greatly diminished in amount and occurred with less frequency (table 1).

*Ulcerations of the Nasal Septum.*—There was a defect of the septal mucous membrane in every case in this group. As a rule the ulceration was no larger than from 3 to 4 mm. at its longest diameter, but ulcerations as wide as 1 cm. were found in two cases. The ulceration was as a rule single and located on one side of the septum, usually anteriorly. A history of nasal "picking" was obtained from only one patient.

Of the fifteen patients in this group, eight were under 30 years of age, and five were between 40 and 60 years. Twelve were females, and three were males. The duration of the epistaxis in these patients was as follows: Three bled for twenty years; two, from five to ten years; four, from one to five years, and six, less than one year. Ten of the patients experienced daily episodes of nasal bleeding. Of the five remaining patients, four had from two to four nosebleeds a week and the fifth, one a week.

In eleven of the patients the epistaxis ceased completely after the first several injections of the venom. In the other four there was marked control of the bleeding.

It is of interest that the ulcerations healed in nine patients and showed improvement in two patients while under treatment (table 2).

*Bleeding Without Visible Source.*—The twelve patients in this group presented a history of repeated epistaxis, but no evident source for the bleeding could be found. Four of the patients belonged to the first decade and five to the fifth. Seven were females, and five were males. The duration of the epistaxis was as follows: One patient bled for fifteen years; two, from five to ten years; eight, from one to five years, and one, less than one year. Four patients had daily recurrences, two bled several times a week and six bled several times a month.

In eight patients the epistaxis was completely arrested after the treatment, and in three instances it was diminished (table 3).

*Hemangioma.*—Of interest were two patients with hemangioma who appeared for treatment. Both patients were women. One presented a history of profuse daily hemorrhages for twenty years in spite of repeated cauterizations and applications of radium. The venom caused a marked diminution of bleeding in a short time. This patient required injections at intervals (maintenance dose) for more than a year. At the end of that time the hemangioma had decreased to one-fourth the original size.

The other patient had been experiencing nosebleeds every other day for seven months. Under treatment the bleeding also diminished. After three months of injections of venom the hemangioma, which originally was 3 by 3 mm. in size, showed signs of complete atrophy and was picked off the septum. There was no subsequent bleeding for a period of two months (table 4).

TABLE 1.—*Data on Patients with Telangiectasis Treated with Snake Venom*

TABLE 1.—*Data on Patients with Telangiectasis Treated with Snake Venom*

| Case No. | Age, Years | Sex | Duration of Bleeding | Frequency of Bleeding Before Treatment | Duration of Active Treatment | Local Reaction | Results | Bleeding During Period of Treatment | Duration and Results of Follow-Up Study |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 31 | M | 4 years | Daily for 3 months | 4 months | Severe | Controlled immediately | Three times, once during desensitization and twice after a two week interval of no treatment | ..... |
| 2 | 12 | M | 9 years | Several times every month; profuse | 4 months | Fairly severe | Controlled after second injection | Slight bleeding twice, once during desensitization | ..... |
| 3 | 15 | F | 2 years | Daily for 3 months | 2 months | Moderate | Controlled immediately | Once during desensitization | ..... |
| 4 | 9 | M | 5 years | Several times every week | 7 weeks; 3 weeks interval with no treatment | None | Controlled immediately | During interval of no treatment | 10 months; no bleeding |
| 5 | 18 | F | 6 years | Several times for 1 week every month (no relation to menstruation) | 2 months | None | ..... | Once after second injection | ..... |
| 6 | 21 | F | Many years periodically | Daily for 3 days preceding treatment | 3 weeks | Slight | Controlled immediately | None | 4 months; no bleeding |
| 7 | 7 | M | 2 years | Several times a week | 6 weeks; 1 week interval with no treatment followed by 1 week of treatment | Moderate | Controlled immediately | Slight bleeding after interval of no treatment | 2 months; no bleeding |
| 8 | 10 | M | 2 months | Daily | 7 weeks | Moderate | Controlled immediately | Once after beginning of desensitization | ..... |
| 9 | 55 | F | 3 years periodically; frequently | Several times a week | 15 months | None | Diminution of bleeding | Amount of bleeding considerably less; much longer free intervals | ..... |
| 10 | 22 | M | 3 months (history during childhood) | Daily | 2 months; 5 month interval with no treatment followed by 2 weeks of treatment | Moderate | Controlled immediately | Every day for a week after a 5 month interval; controlled immediately on resumption of treatment | ..... |
| 11 | 15 | F | Every summer for 3 years; for 3 months preceding treatment | Daily | 2 weeks | Severe | Diminution of bleeding; considerably less bleeding immediately | ..... | 2 months; no bleeding |
| 12 | 25 | F | 20 years | 3 times a week | 1 year | None | Diminution of bleeding | Marked diminution; weeks without bleeding (marked telangiectasia) | ..... |
| 13 | 25 | F | 20 years | 3 times a week | 1 year | None | Diminution of bleeding | Occasionally 1 or 3 times a month (considerable telangiectasia and Osler's disease) | ..... |

TABLE 2.—*Data on Patients with Ulcerations Treated with Snake Venom*

| Case No. | Age, Years | Sex | Duration of Bleeding | Frequency of Bleeding Before Treatment | Duration of Active Treatment | Local Reaction | Results | Bleeding During Period of Treatment | Effect of Treatment on Ulcer | Duration and Results of Follow-Up Study |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 22 | M | Many years; cauterized without success | Daily for 1 week | 3 weeks | None | Controlled immediately | None | ..... | ..... |
| 2 | 21 | M | 6 months | Daily for 2 weeks | 3 weeks | Moderate | Controlled immediately | None | ..... | ..... |
| 3 | 22 | F | 20 years | Daily for past month | 1 month | None | Controlled immediately | Once, after a week of no treatment | Ulcer healed | ..... |
| 4 | 49 | M | Several years | Daily for 1 year | Over period of 8 months | None | Amount of bleeding diminished | Several drops about once a week | Ulcer showed signs of healing | ..... |
| 5 | 45 | M | 6 months | Daily for 2 weeks | 2 months followed by free interval of 10 months, then 1 week of treatment | Moderate | Controlled immediately | About once every 2 weeks; small amounts | Ulcer healed | 10 months after first treatment; no bleeding for 4 months and since then occasional staining |
| 6 | 49 | F | 4 weeks | Several times a day | 1 week | ..... | Controlled immediately | None | ..... | ..... |
| 7 | 25 | M | 3 weeks | Daily | 3 weeks | Slight | Controlled immediately | Twice | Ulcer healed | ..... |
| 8 | 6 | M | 3 years | 3 or 4 times weekly | Over a period of 8 months | None | Controlled immediately | After first 3 injections, no treatment for 6 weeks; daily bleeding for last 4 weeks; controlled immediately; occasional slight nosebleeds | Ulcer healed | 3 months; no bleeding |
| 9 | 52 | M | 2 years | Twice a week; considerable bleeding | 4 months | None | Considerably less bleeding | Occasional staining | Ulcer healed | 2 months; occasional bleeding but increasing; patient admits beneficial effect of venom |
| 10 | 43 | F | About 1 year | Daily | 1 month | None | Controlled immediately | None | Ulcer healed | 8 months; no bleeding |
| 11 | 14 | M | 1 year; cauterized 4 times | Once a week | 3 months including interval of 1 month | None | Less bleeding | Occasional bleeding; definite diminution (during 1 month without treatment bleeding increased) | ..... | ..... |
| 12 | 9 | M | 3 years | Twice a week | 2½ months | None | Controlled immediately | Once | Evidence of healing | 5 months; no bleeding |
| 13 | 9 | M | 8 years | 2 or 3 times a week | 1 month | None | Less bleeding | Three times | Evidence of healing | 6 months; no bleeding |
| 14 | 31 | M | 20 years | Daily for 1 week | 2 weeks | Severe | Controlled immediately | ..... | Ulcer healed | Occasional slight recurrence after 2 years |
| 15 | 30 | M | 20 years | Daily for 5 months | 4 months | Moderate | Controlled immediately | ..... | Healed | 2 years; no bleeding (previous repeated cauterization) |

TABLE 3.—*Data on Patients with Epistaxis from No Visible Source Treated with Snake Venom*

| Case No. | Age, Years | Sex | Duration of Bleeding | Frequency of Bleeding Before Treatment | Duration of Active Treatment | Local Reaction | Results | Bleeding During Period of Treatment | Duration and Results of Follow-Up Study |
|---|---|---|---|---|---|---|---|---|---|

TABLE 3.—*Data on Patients with Epistaxis from No Visible Source Treated with Snake Venom*

| Case No. | Age, Years | Sex | Duration of Bleeding | Frequency of Bleeding Before Treatment | Duration of Active Treatment | Local Reaction | Results | Bleeding During Period of Treatment | Duration and Results of Follow-Up Study |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 4 | M | 1 year | Several times a month | 1 month; no treatment for 11 months; resumed for 6 weeks | None | Amount of bleeding less; free intervals longer | Once during first month; daily for 2 weeks before second course of treatment; stopped immediately and then bled once | ..... |
| 2 | 6 | M | 5 years | Twice a week | 1 month | None | Controlled immediately | None | 4 months; no bleeding |
| 3 | 46 | M | 2 years | Considerable bleeding for 2 weeks | 3 months; no treatment for 7 months; resumed for 6 weeks | None | Marked diminution | About once a week | 7 months, once every 2 or 3 weeks; during 6 weeks of second course bled 3 times |
| 4 | 24 | M | 6 years | Daily | 3 months | None | Marked diminution | Bled 8 times (dilated vessels appeared) | 7 months; bled once |
| 5 | 49 | F | 2½ years | Once every 2 weeks | 2 months | Moderate reaction | Controlled immediately | None | ..... |
| 6 | 3 | M | 2 years | Daily | 1 month | None | Controlled immediately | None | 1 month; no bleeding |
| 7 | 13 | F | 1 week; past history of bleeding | Daily | 2 months | Slight | Controlled immediately | Few drops on 3 occasions | 2 months; no bleeding |
| 8 | 7 | F | Prone to bleeding during winter months | Twice during month | Over period of 3 months | Moderate | ..... | Bled once, slightly | 1 month; very slight bleeding once |
| 9 | 19 | F | 1 year | Once a week | 1 month | Very slight | Controlled | None | 1 month; very slight bleeding once |
| 10 | 49 | F | 15 years | Once every 1 or 2 weeks | 1 month | None | Controlled | None | 4 months; no bleeding |
| 11 | 45 | F | 2 years | Twice a month | 3 weeks | None | Controlled | None | 2 months; no bleeding |
| 12 | 44 | F | 2 years | Daily for 1 week | 2½ months | Moderate | Controlled immediately | None | ..... |

TABLE 4.—*Data on Patients with Hemangiomas Treated with Snake Venom*

| Case No. | Age, Years | Sex | Duration of Bleeding | Frequency of Bleeding Before Treatment | Duration of Active Treatment | Local Reaction | Results | Bleeding During Period of Treatment | Duration and Results of Follow-Up Study |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 47 | F | 20 years (profuse); repeated cauterization and radium | Daily | Over a period of a year | None | Marked diminution | Occasionally requires maintenance dose | Hemangioma decreased to one fourth its size |
| 2 | 38 | F | 7 months | Every other day | 3 months | None | Definite diminution | Very occasionally | Original hemangioma, 3 by 3 mm.; atrophied and was finally picked off of septum; no bleeding for 2 months |

COMMENT

Recurrent epistaxis usually presents a difficult therapeutic problem. A good number of these patients had subjected themselves to cauterization of the bleeding areas without relief. Topical applications are certainly of no avail in cases in which no bleeding point can be seen and are not feasible when telangiectasia of an entire nasal septum is encountered.

In addition to the favorable results obtained in these cases of nasal bleeding, the observations cited in connection with the Shwartzman phenomenon appear to substantiate the conception that the venom exerts its therapeutic effect by acting on the capillaries and on the smaller blood vessels. In our patients the effect was most likely on the smaller vessels of the nasal mucosa.

In a number of instances one or two injections of snake venom sufficed to control the bleeding completely. Many of the patients after a course of therapy (from four to eight injections) were free from bleeding for from six months to a year. Others after a lapse of months had a tendency to recurrence, but even in these cases the hemorrhages lessened in frequency and in severity. Such patients required further injections of venom at intervals of from two to four weeks to control the symptoms completely. Such subsequent treatment has been termed "the maintenance dose."

The following observations made during the period of treatment of these patients are offered as further evidence to substantiate the claim that the cessation of bleeding is due to the action of the snake venom and is not just a casual occurrence. When bleeding was controlled by two injections a week of large doses it was often necessary to reduce the amount markedly because of the development of hypersensitivity. With the reduction in the dose there was often a mild recurrence of the epistaxis. This was soon brought under control when the full dose was again given. Patients who for some reason or other stopped attending the clinic after control of their symptoms often returned because of recurrences of the epistaxis. Such bleeding soon ceased when they again received injections of snake venom.

All of our patients were observed once or twice weekly for at least two or three months. Twenty-one of the forty-two patients returned for follow-up study. The interval periods for these patients were as follows: two years, two patients; ten months, two patients; eight months, one patient; seven months, two patients; five months, one patient; four months, three patients; three months, one patient; two months, six patients, and one month, three patients.

In fourteen of these patients there was no recurrence of nasal bleeding. In the other seven patients there were occasional mild episodes of

epistaxis. In every one, however, there was no doubt that a beneficial effect was recognized as occurring after the administration of the snake venom. A more detailed report on each of these cases can be found in the tables.

For the proper evaluation of the snake venom therapy, the patients were exposed to only this form of treatment. In the regular care of recurrent epistaxis it is expected that sinus infections will be treated, deviated septums corrected when necessary and obvious bleeding points cauterized. The snake venom is being offered as an additional and valuable therapeutic agent for the treatment of persistent and troublesome recurrent epistaxis.

SUMMARY

Forty-two patients with recurrent epistaxis without any form of blood dyscrasia were treated with subcutaneous injections of moccasin snake venom. The patients could be grouped according to the source of bleeding as follows: (1) telangiectasia of the nasal septum, (2) ulcerations of the nasal septum, (3) bleeding without a visible source and (4) hemangioma of the nasal septum. No other adjuvant treatment was given. The venom therapy was effective in practically all instances either in completely arresting and controlling the nasal bleeding or in markedly diminishing its amount and frequency.

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# THE UTRICULO-ENDOLYMPHATIC VALVE

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In 1928 Bast [1] described a fold in the posterior wall of the utricle at the site of the utricular duct which he named the utriculo-endolymphatic valve. This name was suggested by its anatomic structure and position. It appeared to guard the opening of the utricular duct into the utricle. This structure was seen first in sections from the ear of a human fetus. In 1929 Wilson and Anson [2] described the structure in a child, and later that year they also described it in the adult human ear,[3] having observed it in eleven different specimens. A thorough study with reconstructed models of the utriculo-endolymphatic valve as it occurs in different animals was made in 1931 by Hoffman and Bast,[4] who concluded that this structure "is a definite and constant feature of the membranous labyrinth of the mammalian ear." Roberts [5] studied the utriculo-endolymphatic valve in the albino rat and described a mound of tissue directly opposed to the utriculo-endolymphatic valve consisting of compact fibrous connective tissue, which he named the "eminentia junctionis ductorum." He expressed the belief that it could "serve as a resisting opposing mass which may serve to complete, with the valve cusp, the occlusion of the duct."

Experimental attempts to demonstrate the function of this fold have been generally unsuccessful. However, several specimens of pathologic temporal bones were described by Bast [6] in 1934 which strongly suggest

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1. Bast, T. H.: The Utriculo-Endolymphatic Valve, Anat. Rec. **40**:61, 1928.

2. Anson, B. J., and Wilson, J. G.: The Utricular Fold in the Adult Human Ear, Anat. Rec. **43**:251, 1929.

3. Wilson, J. G., and Anson, B. J.: The "Utriculo-Endolymphatic Valve" (Bast) in a Two-Year-Old Child, Anat. Rec. **43**:145, 1929.

4. Hoffman, E. F., and Bast, T. H.: A Comparative Study of the "Utriculo-Endolymphatic Valve" in Some of the Common Mammals, Anat. Rec. **46**:333, 1930.

5. Roberts, J. T.: On the Utriculo-Endolymphatic Valve in the Albino Rat, Anat. Rec. **53**:255, 1932.

6. Bast, T. H.: Function of the Utriculo-Endolymphatic Valve: Two Cases of Ruptured Saccules in Children, Arch. Otolaryng. **19**:537 (May) 1934.

its valvular action. In his sections from two temporal bones, he observed a tear in the saccule with collapse of the saccule and the cochlear duct, but with no change of the utricle. The utricle was apparently normally distended and showed an intact utriculo-endolymphatic valve, which appeared to occlude the opening of the utricular duct. In this article Bast reviewed the clinical reports of deafness following trauma and associated with normal vestibular function, suggesting an explanation on the basis of a functioning utriculo-endolymphatic valve. He also called attention to pathologic studies of the inner ear which have shown a collapsed saccule and a partially collapsed cochlear duct together with a normally distended utricle. A further observation, reported by Bast [7] before the American Otologic Society in 1935, concerns experimental proof of the valvular action of this fold. In the course of investigations on cochlear potentials in a guinea-pig, he succeeded in puncturing the cochlear duct without entering the scala vestibuli or the scala tympani and in aspirating a small quantity of endolymphatic fluid. Later, on studying the sections of this ear, he noted a collapsed cochlear duct and saccule but no change in the shape of the utricle.

From a perusal of the literature it is apparent that the extent of the observations on this structure have been limited, suggesting that neither its existence as an anatomic entity nor its function as a valve has received wide acceptance. This is probably in part due to the difficulty in demonstrating in undistorted detail the membranous structures in the vestibule of the labyrinth. Also, the utriculo-endolymphatic valve and the utricular duct are very small, the former measuring about 0.7 mm. in its greatest width (Wilson and Anson [3]) and the latter about 0.1 in diameter (Bast). A further obstacle to its study is the difficulty in cutting sections in such a plane to show the full extent of the valve together with the utricular duct.

A review of our collection of sections of temporal bones has revealed a demonstrable utriculo-endolymphatic valve in eight human ears as well as in the ears of seven rabbits, two cats and one guinea-pig. Two specimens are of particular interest. One is from a 6 month fetus and the other from a 7 month old infant. The fetus lived for ten minutes, and autopsy was performed thirty hours later. Postmortem examination revealed a cerebral hemorrhage. The sections illustrated in figures 1 and 2 showed a particularly dense acellular amorphous substance filling the utricle, in contrast to the rather scanty amount of this material in the saccule and the cisterna perilymphatica. In general, this type of acellular trabecular material resembles that seen in all of our sections

7. Bast, T. H.: Tr. Am. Otol. Soc., 1934.

of fetal temporal bones. The distribution of this material in this case, however, indicates some physical or chemical differences in the contents of the utricle as compared to the adjacent spaces in the vestibule. Also, it can be seen that the precipitate in the utricle is heaviest along the utricular surface of the valve, particularly at the region of the opening of the utricular duct. It would appear, therefore, from these sections that the utricular fold forms a barrier between the utricle and the utricular duct and that it may act as a valve preventing outflow from the utricle.

Fig. 1.—Photomicrograph (×40) of a section through the right labyrinth of a 6 month human fetus, showing a dense precipitate in the utricle (*PPT*). *U* indicates the utricle; *S*, the saccule; *UD*, the utricular duct; *UEV*, the utriculo-endolymphatic valve.

The section illustrated in figure 3 is from the right ear of a 7 month old infant who died of bronchopneumonia following measles and otitis media on the right side. The sections through the inner ear show that the fluid within the utricle and the semicircular canals stained with hematoxylin and eosin, while the other endolymphatic spaces, as well as the perilymphatic spaces, show up in the marked contrast. The affiinity of the endolymph within the utricle and the canals for the stain indicates some alteration in its chemical constitution and resembles the staining reaction of the labyrinth fluids sometimes seen in early labyrinthitis.

The difference in staining reaction between the contents of the utricle and the utricular duct again suggests the action of the utricular fold as a barrier guarding outflow from the utricle.

The horizontal sections illustrated in figures 4 and 5 are from the right ear of an 11 year old boy who died of tuberculous meningitis as a complication of Pott's disease. One sees the utricular fold as it forms the posterior medial wall of the utricle and the anterior wall of the tangential utricular duct. The fold is covered by a cuboidal epithelium,

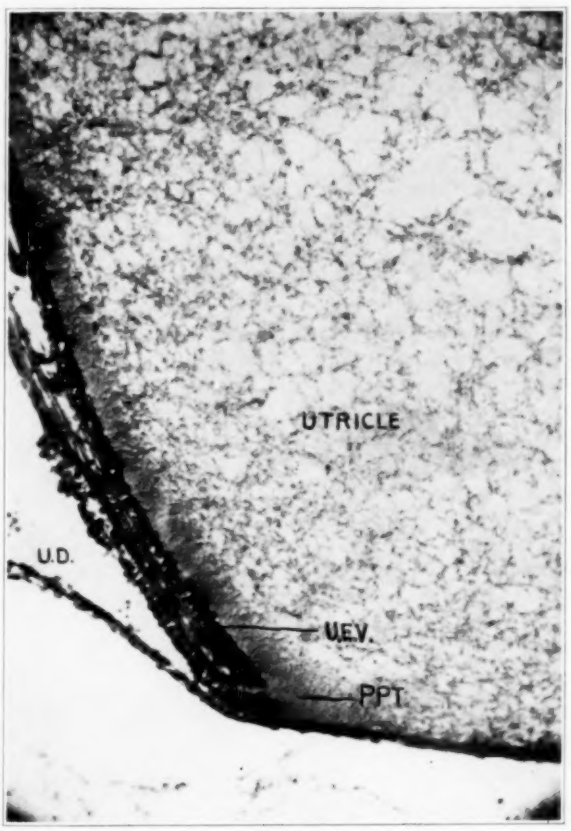



Fig. 2.—Higher power view (× 150) of the region of the utriculo-endolymphatic valve, showing the dense precipitate (*PPT*) against the utriculo-endolymphatic valve (*UEV*) and the utricular duct (*UD*) free from precipitate.

which becomes flattened on the side entering into the formation of the utricular duct. The core of the fold consists of a thin subepithelial layer of dense connective tissue and a central area of areolar tissue. The connective tissue arises from a shelf of bone which forms the anterior lip of the apertura interior aqueductis vestibuli.

In the distal portion of the fold the connective tissue becomes more abundant, replacing the loose areolar tissue in the core and giving to the free border of the fold a somewhat thickened rounded contour. The connective tissue fibers are mostly arranged lengthwise to the direction of the utricular duct except for a small central bundle in the foot, which appears to be arranged transversely. Figure 6 shows a

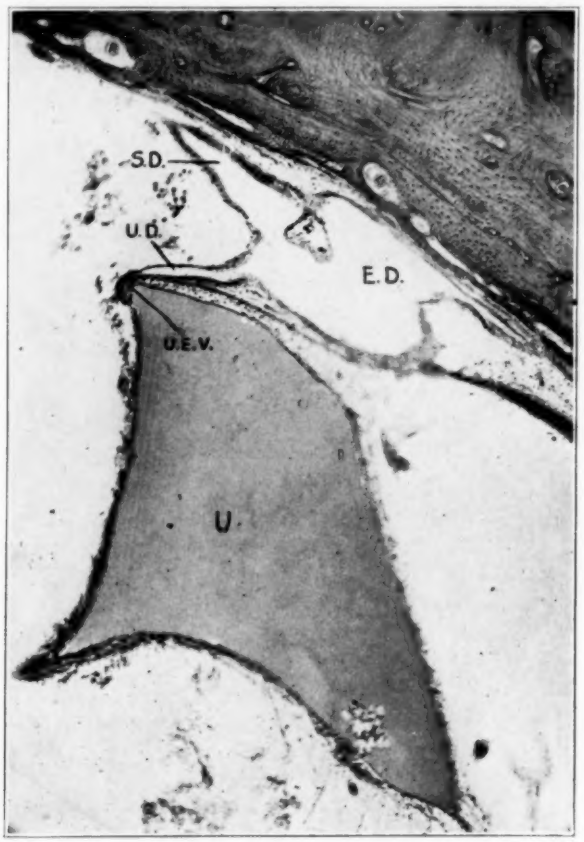



Fig. 3.—Photomicrograph (× 54) of a section through the right labyrinth of a 7 month old infant, showing coagulum in the utricle (*U*) and the absence of coagulum in the adjacent utricular duct (*UD*), the saccular duct (*SD*) and the endolymphatic duct (*ED*). *UEV* indicates the utriculo-endolymphatic valve.

horizontal section through the vestibule of a rabbit's ear. It illustrates the endolymphatic duct as a direct continuation of the saccular duct, whereas the utricular duct comes off the utricle in a tangential direction and joins the saccular duct at slightly less than a right angle. This

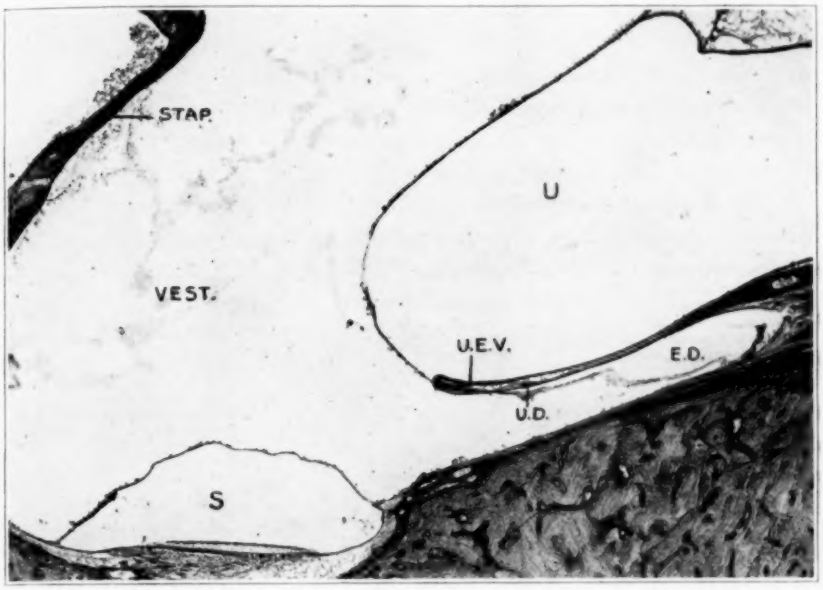



Fig. 4.—Photomicrograph (× 23) of a section of the left ear of an 11 year old boy, showing the general character of the utriculo-endolymphatic valve in the adult form. *STAP* indicates the foot-plate of the stapes; *VEST*, the vestibule; *U*, the atricle; *S*, the saccule; *UEV*, the utriculo-endolymphatic valve; *UD*, the utricular duct, and *ED*, the endolymphatic duct.

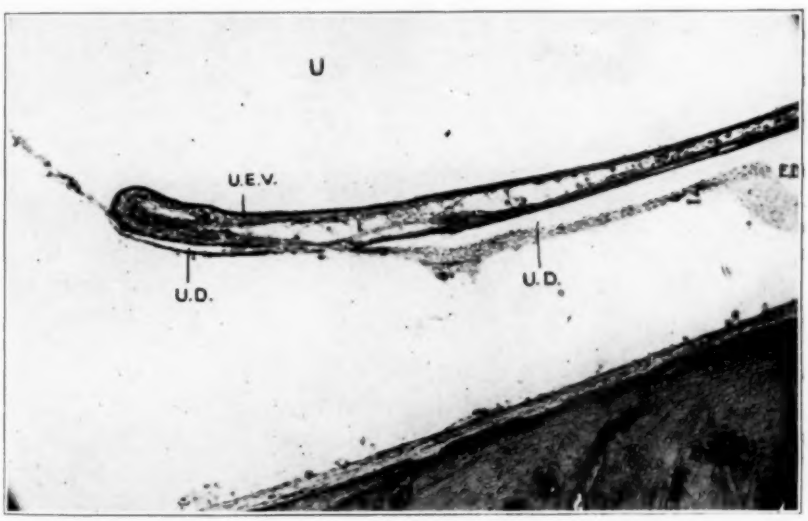



Fig. 5.—Higher power photomicrograph (× 77) of the utriculo-endolymphatic valve. *U* indicates utricle; *UEV*, the utricular-endolymphatic valve; *UD*, the utricular duct, and *ED*, the endolymphatic duct.

arrangement of the utricular duct along the utricular fold or valve would appear to provide a mechanism whereby the contents of the utricle and the semicircular canals are maintained in relative isolation.

The mound of tissue described by Roberts as the eminentia junctionis ductorum, which provides a support to the wall of the utricular duct opposite the utricular fold, was not evident in any of our specimens.

The close apposition of the utricular wall to the extremity or foot of the fold, noted in all of our specimens and shown in the illustrations, further strengthens the impression that the fold may function as a valve.

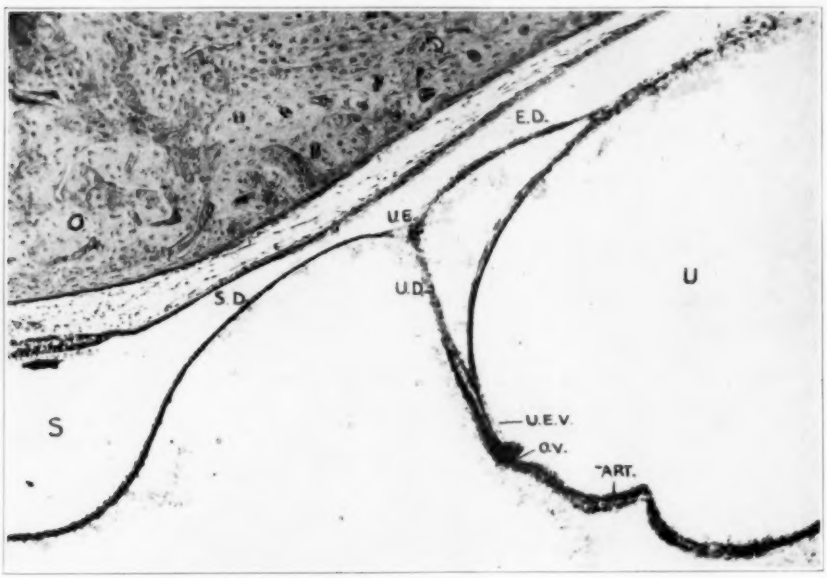



Fig. 6.—Photomicrograph (× 83) of a section of the right ear of a rabbit, showing the connections of the utricle and endolymphatic duct. *U* indicates the utricle; *UEV*, the utriculo-endolymphatic valve; *OV*, the opening of the utricular duct into the utricle; *UE*, the opening of the utricular duct into the endolymphatic organ; *UD*, the utricular duct; *S*, the saccule; *SD*, the saccular duct; *ED*, the endolymphatic duct; *ART*, folds in the wall of the utricle probably artefact.

## SUMMARY

The temporal bones in our collection have not been sectioned with any special purpose of demonstrating the utricular fold. However, in ears which happen to have been sectioned in a favorable plane, the utricular fold has been found with enough regularity to indicate that it is a normal anatomic structure in the human ear. The presence of such a definite structure would seem to indicate that some physiologic function is served.

The arrangement of the utriculo-endolymphatic valve as well as the relation of the utricular duct to the saccular and the endolymphatic duct appears to indicate the function of the valve in maintaining the content or volume of the utricle and canals at a constant level.

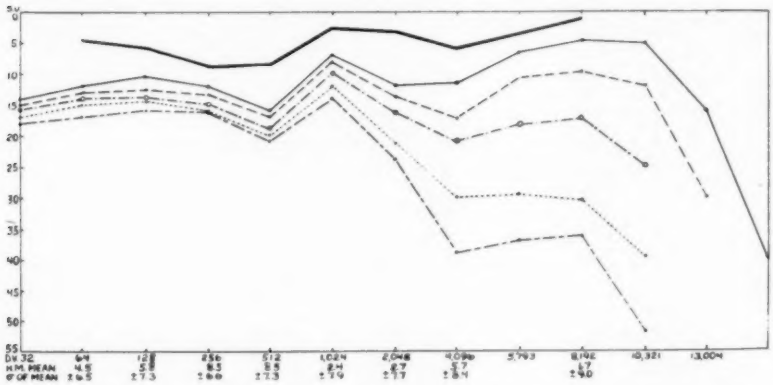
It is known that changes in the pressure of the labyrinthine fluid occur in response to changes in pressure in the external canal, middle ear and cerebrospinal fluid. It is well known clinically, however, that great changes in pressure in the external canal and the middle ear, such as are produced by the fistula test and inflation of the middle ear, do not excite a vestibular response. A satisfactory explanation is also lacking as to why dynamic waves, even of high amplitude, entering the vestibule, do not excite any disturbance of the sense organs in the ampullae and utricle. It appears likely that these disturbances or waves within the perilymph are not translated into fluid movements within the semicircular canals and utricle and also that the content or volume of the utricle and canals is not disturbed.

Further studies, both by means of models and by experiments on animals, are necessary in order to determine whether or not the utricular fold has a physiologic function as a valve and what the effect of such a valve may be in insulating the utricular contents from fluid movements or pressure changes within the perilymph.

# AVERAGE AND RANGE OF ACUITY OF HEARING OF HIGH SCHOOL PUPILS

IRENE B. YOUNG, M.A.
TENAFLY, N. J.

The Horace Mann School of Teachers College, Columbia University, has conducted a study of hearing during the past five years on pupils at the Horace Mann High School which yielded the accompanying figures and graph. These results may be of general interest as they were obtained on subjects belonging to a decade lower than those studied by Bunch.[1]



A graph (the solid line) showing the mean hearing of 209 girls at the Horace Mann High School.

The lighter lines show the mean hearing in the succeeding decades, from 20 to 30, 30 to 40, 40 to 50, 50 to 60 and 60 to 70 years, as determined by Bunch.

The graph of mean hearing is presented on the chart, and the graphs of Bunch for the succeeding five decades are reproduced in lighter lines. The age range at the Horace Mann High School is from 9 years and 8 months to 19 years and 3 months, the mean lying at 13 years and 9 months. Only two subjects were less than 10 years of age.

The 2-A audiometer was used. All tests were given by me. The same method was used throughout, and the conditions of testing were consistent. The tests were made in a semisound-proof room, the walls being insulated, with double doors, but the floor transmitting certain sounds and intense traffic noises entering occasionally. When such sounds intervened, the test was interrupted until the sound ceased.

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1. Bunch, C. C.: Further Observations on Age Variation in Auditory Acuity, Arch. Otolaryng. **13**:170 (Feb.) 1931. Bunch, C. C., and Raiford, T. S.: Race and Sex Variations in Auditory Acuity, ibid. **13**:423 (March) 1931.

The technic of administration consisted essentially of the following routine: 1. One or more tones were produced at a low intensity, the tones being increased to moderate loudness until the pupil understood the type of sound to which she was to attend. 2. The tone was increased from below the threshold of hearing to the point at which the pupil signaled that she heard the tone. 3. The results were checked and rechecked to establish that point of recognition with certainty.

Two reasons may be advanced for the obtained mean lying above the expected norm calculated from the data of Bunch. Testing conditions were unquestionably more favorable than in a hospital ward, the average for school room conditions (previous year's tests) being somewhat lower on the vertical scale. Secondly, the intelligence quotient of the population of the Horace Mann High School, lying between 98 and 167, secures a most intelligent and cooperative response in every case and operates to reduce errors due to inattention and lack of discrimination.

For more accurate comparison, the sigmas are indicated for the means for each tone of the norm at the Horace Mann High School.

# DISLOCATION OF THE LOWER END OF THE NASAL SEPTAL CARTILAGE

## A TREATISE DEALING WITH DISLOCATIONS OF THE LOWER END OF THE NASAL SEPTAL CARTILAGE IN THE NEW-BORN (INJURY SUSTAINED AT BIRTH), IN INFANTS AND IN YOUNG CHILDREN AND WITH THEIR ANATOMIC REPLACEMENT BY ORTHOPEDIC PROCEDURES

MYRON METZENBAUM, M.D.

CLEVELAND

In most of the vertebrates, from the serpent to the ape, the two nasal bones extend from the frontal bone to the end of the nose, forming a bony roof over the entire length of the nose (fig. 1). In most members of the ape family and in the human family the two nasal bones begin at the frontal bone and extend only from the frontal bone to the end of the nasal portions of the maxillary bones, so that in man the two

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A paper entitled "Replacement of the Lower End of the Dislocated Septal Cartilage Versus Submucous Resection of the Dislocated End of the Septal Cartilage" was read before the Section on Laryngology, Otology and Rhinology at the seventy-ninth annual session of the American Medical Association, in Minneapolis, June 14, 1928. In June 1916, at the meeting of the American Medical Association in Detroit, the principles announced in the paper entitled "Asymmetry of the Nares—A Positive Diagnostic Sign or Entity Establishing Anatomic Displacement of the Lower End of the Cartilaginous Nasal Septum" were brought out in a scientific exhibit on nasal reconstructive surgery. The entire subject was presented in detail, by means of a series of plaster models and photographs and by the presentation of clinical cases as observed before and subsequent to operation, before the Scientific Section of the American Medical Association at its meeting in Detroit, June 23-27, 1930, and in Cleveland, June 11-15, 1934, and before the Scientific Section of the Interstate Postgraduate Medical Association of North America at its meetings in Cleveland in October 1927 and October 1933 and at Detroit in October 1935. This subject was also presented in a diagnostic and operative clinic at the Graduate Hospital of the University of Pennsylvania in Philadelphia and before the Philadelphia Laryngological Society on Nov. 3, 1931. It was likewise presented in a diagnostic and operative clinic at the meeting of the Clinical Congress of the American College of Surgeons at the Cook County Hospital in Chicago on Oct. 9, 1933. It was likewise presented on May 27, 1936, in a diagnostic and operative clinic at the Victoria Hospital before the Ear, Nose and Throat Section of the Ontario Medical Association meeting in London, Ontario, Canada, and at a meeting of the Ear, Nose and Throat Section of the Ontario Medical Association on May 28, 1936.

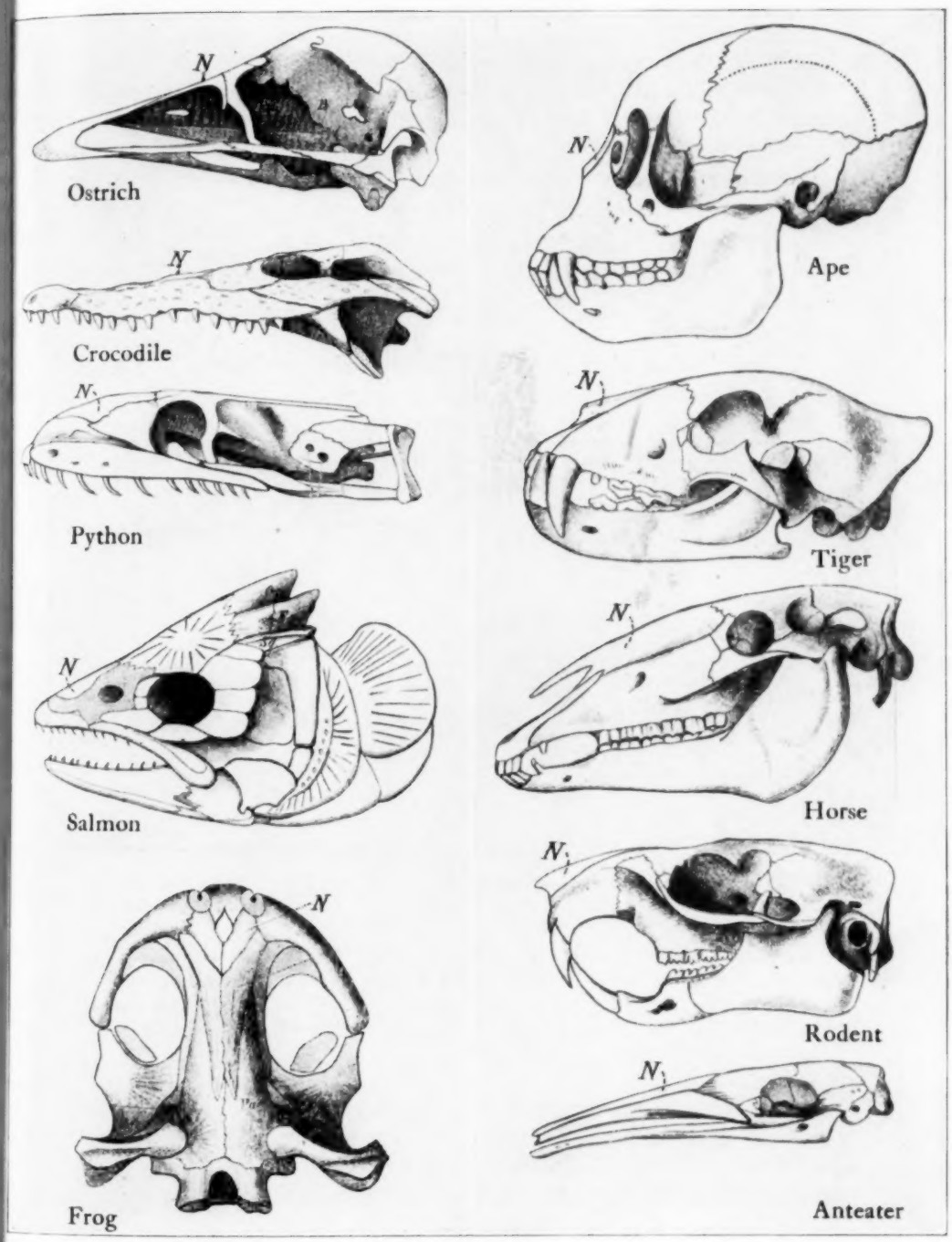


Fig. 1.—Examples showing that in most vertebrates from the snake to the ape the two nasal bones extend from the frontal bone to the end of the nose (*N*), forming a bony roof over nearly the entire length of the nose. Often the two nasal bones extend beyond the ends of the maxillary or premaxillary bones to form beaks or bills for defense purposes.

nasal bones form a bony roof for only the upper half of the nose. The lower half of the nose is made up entirely of cartilages and soft tissues and contains no bony supporting structures.

### ORIGINAL BIOLOGIC EXPLANATIONS FOR THE DIFFERENT CHARACTERISTICS OF THE NOSE IN MAN

For this striking difference which exists between the bony formation of the lower half of the nose in most vertebrates and the cartilaginous and fleshy lower half of the nose in human beings, I offer the following explanations:

1. Examination of the skulls of human embryos shows that after about the seventh fetal month the lower ends of the two nasal bones

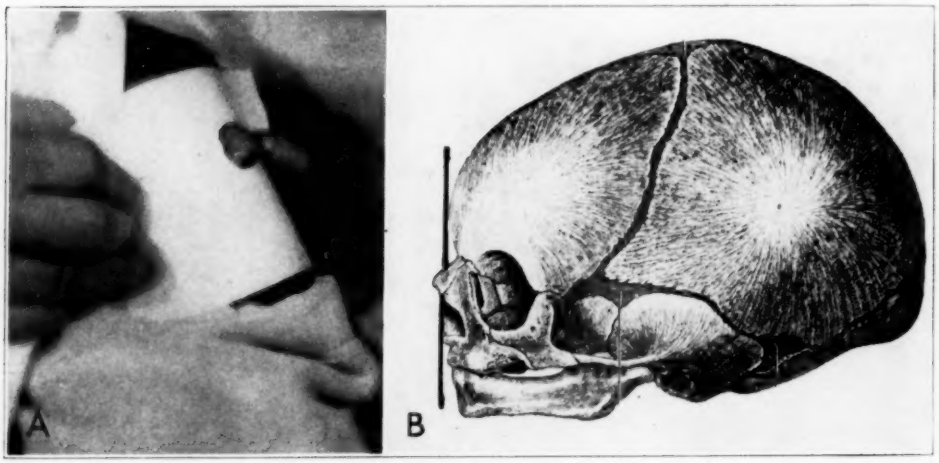


Fig. 2.—*A* shows a cardboard with a hole for the protrusion of the nose placed firmly against the forehead and chin of a new-born infant. This demonstrates how far the flexible lower half of the nose in the new-born infant projects anterior to the frontal maxillary plane. *B* shows the skull of a fetus at birth. A line drawn from the frontal bone to the maxillary spine shows the lower ends of the nasal bones only a few millimeters anterior to this plane. The flexible cartilaginous lower half of the nose is still farther anterior and must be compressed or deflected in order to pass through the pelvic canal.

are slightly anterior to a plane extending from the forehead to the chin. The flexible tip of the nose is still more anterior to this plane. If the lower half of the nasal framework in the human fetus were bony and inflexible like the upper half, it could pass through the normal existing pelvic diameters only with great difficulty. The head, face and nose of a child born by cesarean section are perfect in contour. The head, face and nose of a child born naturally are more or less compressed and distorted. During a normal birth the skull conforms to the diameters

of the osseous pelvis. This is accomplished in the main through the compressibility given to the skull by the anterior and posterior fontanels and through the approaching and overlapping of the cranial bones. The tip of the cartilaginous lower half of the nose which protrudes anterior to a plane extending from the frontal bones to the chin accommodates itself to the pelvic diameters because it is flexible and easily depressed. Soon after birth the elasticity of the septal cartilage springs the depressed lower cartilaginous half of the nose forward.

During the process of birth, when the tip of the nose is depressed, the inferior border of the cartilaginous septum may be, and sometimes is, sprung out of its shallow septal groove in the floor of the nose (incidence, 1 in 200 births—Metzenbaum). When this occurs the cartilage

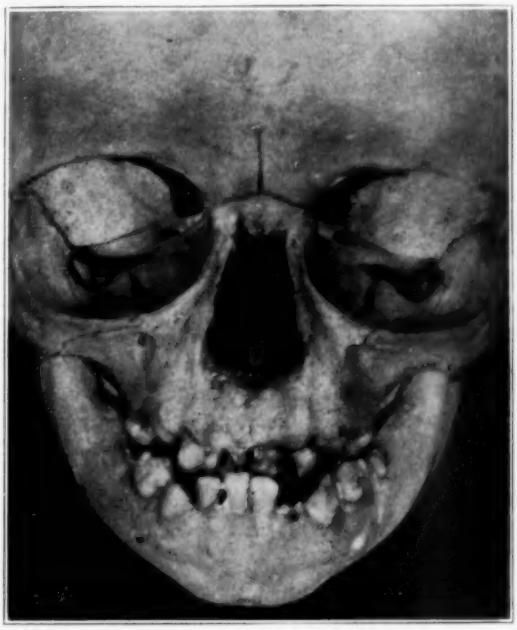

Fig. 3.—The skull of an infant, 17 months old, showing the definite groove in the vomer (the floor of the nose). This groove is formed by the two embryologic plates of the vomer and extends from the sphenoid bone to the maxillary spines. The entire inferior border of the cartilaginous septum is held in this shallow groove. When the tail or the sphenoidal portion of the cartilaginous septum does not extend back to the sphenoid, the inferior border of the perpendicular plate of the ethmoid, instead of being attached to the upper border of the tail of the septal cartilage, is held in the remaining upper portion of the groove in the vomer.

This is possibly the first photograph and description of a definite groove in the floor of the nose for the reception of the inferior border of the bony and cartilaginous septum.

cannot spring back spontaneously into this septal groove, and there results a displacement or a dislocation of the lower end of the nasal septal cartilage, with the lower border of the cartilage lying obliquely across one naris anteriorly; across the opposite naris somewhat higher up there is a bend in the cartilage known as the angle of deflection

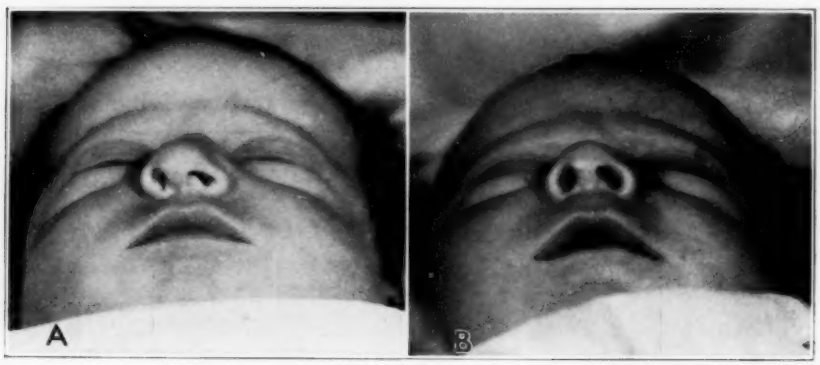


Fig. 4.—*A* shows an infant, 14 days old, who sustained a nasal injury at birth, the lower end of the septal cartilage being dislocated from the septal groove in the floor of the nose with resultant impairment of nasal function. The injury results in difficulty in nursing, impairment of the ingress and egress of air through the nares, impairment of the ventilation to the nasal accessory sinuses, and of the ventilation through the eustachian tubes to the middle ear and possibly to the mastoid cells. Note the asymmetry of the nares and the slanting position of the columella. Note that the free border of the lower end of the cartilaginous septum, covered by skin, not mucous membrane, lies across and partially obstructs the left nostril. In the other nostril, at a higher level, the bent cartilage forms an angle of deflection (Metzenbaum [1]), resulting in partial occlusion. Note the flatness of the left nostril and the lowering of the nasal tip. The nose appears similar to that observed after repair of a harelip and cleft palate.

*B* shows the same infant following the resetting of the dislocated posterior border of the septal cartilage into the anatomic groove in the floor of the nose. The resetting has reestablished the normal symmetry of the nares and the perpendicularity of the columella; the free lower end of the cartilage is replaced back of the columella in the left nostril; the partially obstructing angle of deflection of the septum in the other nostril is corrected, bringing the septal cartilage into the straight midplane position, thereby rendering the left nostril patent; the flattened left nostril is restored to its normal position; the lowered nasal tip is raised, reestablishing the normal perpendicularity of the lower end of the cartilaginous septum, a factor on which normal nasal function depends (Metzenbaum). The total results of the resetting of the dislocated septal cartilage into its normal anatomic position in the new-born and in the infant are normal nursing and normal nasal function, which aid in normal nasal development and in normal development of the upper jaw, teeth and face.

(Metzenbaum [1]). These deflections of the septal cartilage cause a partial or total obstruction or occlusion of one or both nares.

2. A second explanation of why the lower half of the human nose is cartilaginous and flexible instead of bony and firm may be seen in the way nature protects the infant and the young child. Quadrupeds

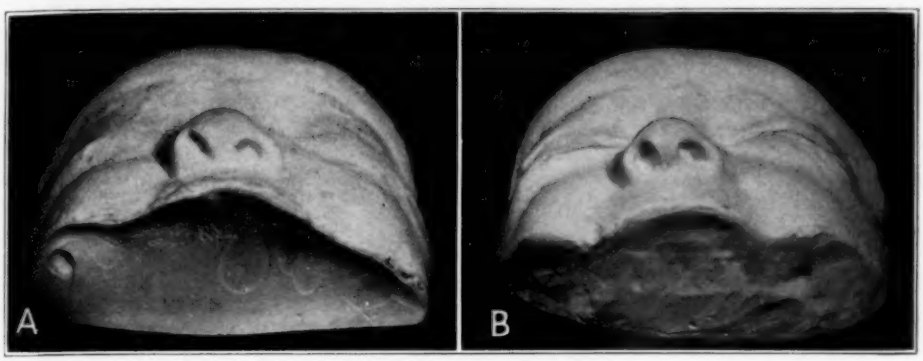


Fig. 5.—*A* shows a plaster cast of an infant, 14 days old, who suffered an injury at birth. Note the asymmetry of the nares, the slanting columella, the lowering of the nasal tip and the flatness of the left side of the nose. The nose appears similar to that observed after repair of a harelip and cleft palate. *B* shows a cast of the same infant following the resetting of the dislocated posterior border of the septal cartilage into the anatomic groove in the floor of the nose. The reduction reestablished the normal symmetry of the nares and the perpendicularity of the columella, raised the nasal tip and restored the flattened left nostril to its normal position.

The plaster models were made directly over the upper half of the face of the infant pictured in figure 4. This represents possibly the first plaster model to be made directly on the face of so young an infant, giving a detailed true impression of the nose and the septal deformity and of its correction.

break their fall by bringing their forelegs into play. When the fully developed child has a tendency to fall forward it extends the arms, which is nature's protective mechanism for breaking the force of the fall. This often results in injuries at the forearm or wrist, such as Colles' fracture. The toddling infant, before it develops this protective mechanism, when it first attempts to walk or run and has a tendency to fall forward, may raise its hands above its head and fall flat on its face, striking the soft and flexible cartilaginous tip of the nose and the upper jaw and frequently injuring both the nose and the jaw.

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1. Metzenbaum, Myron: Asymmetry of the Nares: A Positive Diagnostic Sign or Entity Establishing Anatomic Displacement of Lower End of Cartilaginous Nasal Septum, Arch. Otolaryng. **16**:690 (Nov.) 1932.

If the entire supporting nasal framework were bony like the upper half, especially if the entire septum were bony like the perpendicular plates of the vomer and ethmoid bone (there is a narrow strip of cartilage at the upper end of the perpendicular plate of the ethmoid bone where it attaches to the cribriform plate which does not ossify until the sixth year), a forcible impact on the tip of the nose would be transmitted to the base of the skull, resulting in concussion of the brain or in fracture of the cribriform plate of the ethmoid bone or of the outer plate of the frontal bone.

### RESULTS OF TRAUMATISM TO THE NASAL TIP

In infants and in young children the self-inflicted traumas to the tip of the nose, occurring up to about the tenth year, are usually limited to the lower end of the cartilaginous nasal septum and to the cartilage forming the nasal tip (Metzenbaum [1]). The observations in cases of dislocation are as follows:

1. The anatomic displacement of the lower end of the cartilaginous nasal septum in the new-born, in infants and in young children is always evidenced by Metzenbaum's positive diagnostic sign, namely, an asymmetry of the nares.[1]

2. The lower end of the cartilaginous nasal septum is sprung out of the shallow maxillary groove and out of the shallow groove in the vomer to an extent varying from a small distance to nearly its entire length and presents a free cartilaginous border, covered by skin, anterior to the mucous membrane, partially obstructing the nostril on the same side where the septal cartilage is rendered concave.

3. The dislocated lower portion of the septal cartilage forms a plane which is deflected obliquely across the nasal groove into the opposite nostril, where it forms an anteroposterior deflection or greenstick fracture. This is known as the angle of deflection of the septal cartilage (Metzenbaum [2]).

This angle of deflection is always in the nostril opposite to the dislocated lower border of the septum. This deflection causes more or less obstruction or occlusion of the nostril into which it projects and interferes with more or less of the normal nasal function. The dislocation of the lower end of the septal cartilage removes some of the midsupport to the tip of the nose with the result that the tip of the nose droops and is brought closer to the upper lip, thereby adding another factor which causes more or less interference with normal nasal function and with normal nasal development, since normal nasal

2. Metzenbaum, Myron: Replacement of the Lower End of the Dislocated Septal Cartilage Versus Submucous Resection of the Dislocated End of the Septal Cartilage, Arch. Otolaryng. **9**:282 (March) 1929.

function is dependent on the normal perpendicularity of (the nasal tip) the lower end of the cartilaginous septum (Metzenbaum [2]).

## ORIGINAL EXPLANATIONS FOR THE FORCES SPREADING OR CONTRACTING THE ALVEOLAR PROCESSES AND LOWERING OR RAISING THE PALATAL ARCH

1. When an infant with normal nasal function can breathe comfortably through its nose with its mouth closed, it often forcibly compresses its jaws. Such a frequently applied force tends to spread the upper and the lower alveolar process into two symmetrical semicircles and at the same time lower the palatal arch.

2. When the infant or the young child suffers from a definite nasal obstruction which necessitates keeping the mouth partially open, the buccal muscles exert a lateral contracting pressure on the borders of the alveolar processes, forcing them closer together. At the same time the anterior border of the alveolar process will be pushed forward, resulting in the formation of an elliptic alveolar process and an elevation of the arch of the hard palate.

3. The tongue is nature's orthopedic instrument for the dilatation of the upper and lower alveolar processes (arches) (Metzenbaum). When the infant or the young child has normal nasal function and can breathe readily with the mouth closed, the tongue lies within the upper or within the lower alveolar arch, resulting in a symmetrical and harmonious dilatation and the formation of two semicircular arches.

In the infant or the young child who suffers from a nasal obstruction and is obliged to keep its mouth partly open the tongue does not lie within the upper or the lower alveolar arch but is suspended and protrudes between them. The infant or the young child whose normal nasal function is definitely obstructed by a dislocation of the lower end of the septal cartilage usually develops asymmetrical alveolar arches consequent to the three following factors which are set into motion:

(*a*) The infant or young child cannot close its mouth long enough to exert a continuous pressure on the upper and lower alveolar arches.

(*b*) The tongue cannot function as an orthopedic instrument (Metzenbaum) dilating the alveolar arches.

(*c*) The infant or the young child keeps its mouth open so that the buccal muscles contract and exert lateral pressure on the alveolar arches and force the anterior border of the upper jaw forward.

A dislocation of the lower end of the cartilaginous nasal septum sustained at birth or in infancy or early childhood results in partial or total obstruction of one or both nares and interferes with normal nasal function, namely, the ventilation to the nasal accessory sinuses and through the eustachian tubes to the middle ears and possibly to the mastoid cells.

METHODS OF REDUCTION

My orthopedic methods for replacing the dislocated lower end of the septal cartilage in the new-born, in infants and in young children are as follows:

1. Manual Reduction of a Recent Septal Dislocation: The alae of the nose are made up only of soft tissues and cartilages and do not contain any bone, and therefore they are easily compressed with the thumb and forefinger of the same hand and brought in close contact with the base of the septum. The free border of the dislocated septal cartilage is then rocked and lifted slightly forward until it springs over the edges of the maxillary spine and over the edge of the vomer into the septal groove, usually with an audible snap.

2. Instrumental Reduction of a Recent Septal Dislocation: Should the manual method not be successful, any small flat instrument may be covered with a piece of rubber tubing or wound around with cotton,

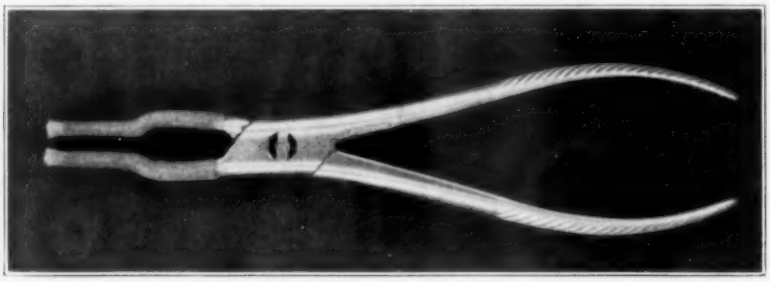

Fig. 6.—Adams' forceps, the blades covered with rubber.

then placed just beneath the dislocated edge of the septal cartilage and raised forward until the cartilage slips over the edge of the maxillary spine and the edges of the vomer into the septal groove. Great care should be exercised to avoid laceration or contusion of the mucous membrane covering the dislocated cartilage. In the new-born the dislocated cartilage can be readily reduced without any form of anesthesia. If the displacement is recent, it is unnecessary to splint the reduced septum, for the muscles of the face contract simultaneously and bilaterally and never cause a spontaneous redislocation of the septum (Metzenbaum [2]).

The cartilage can be readily replaced up to about the third week following the dislocation. After this time the shallow septal groove is more or less obliterated by callus formation. When sufficient time has elapsed for the callus to fill the septal groove and incorporate the base of the dislocated cartilage firmly to the sides of the vomer and the nasal floor, it becomes necessary, in order to reset the dislocated septum, to

follow a definite surgical procedure for the resetting of the dislocated lower end of the septum in young children.

3. Closed Method for Reduction of an Old Dislocation of the Septal Cartilage in Young Children: A reduction of an old dislocation of the septal cartilage in a young child can often be accomplished by the following closed method: The blades of Adams' or a similar septum forceps, covered with rubber tubing, are introduced along the base of the dislocated septal cartilage close to the floor of the nose. Then by a

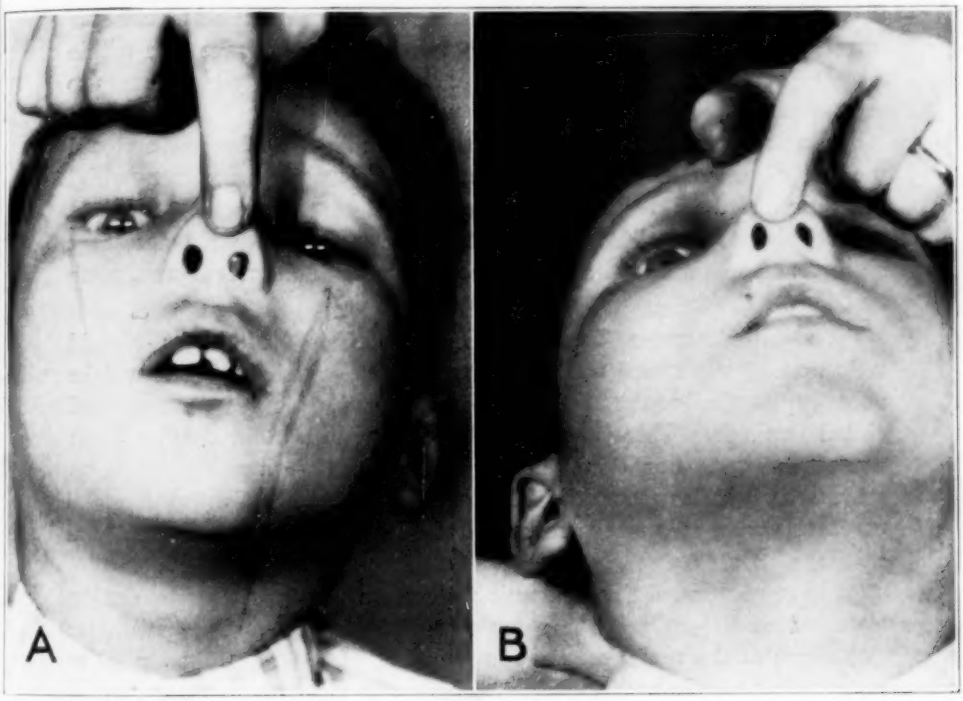


Fig. 7.—At the age of 6 years this boy fell on his face and injured both the tip of his nose and the upper jaw, fracturing the left central incisor. The dislocated septal cartilage was not reset, and the greenstick fracture of the jaw was not wired. The cartilaginous septum rides the floor of the nose as shown in *A*, causing marked nasal obstruction and necessitating mouth breathing. All of these factors operating during the developmental period resulted in the formation of a high palatal arch and a narrow protruding upper jaw. All of the other members of his family and all near relatives have normal dental arches. Resetting of the dislocated cartilaginous septum in the midline reestablished good nasal function, as shown in *B*. Thereafter the child could breathe through his nose, keep his mouth closed, compress his jaws and use his tongue as an orthopedic dilating instrument. The continuous slight pressure of the bilateral facial muscles on the now perpendicular septum contributed to the lowering of the vault. The result of all of these correcting forces operating during the developmental period was a partial but definite orthodontic self-correction.

gentle rocking of the forceps the dislocated portion of the septal cartilage is separated from its false position and gently but firmly forced into the median line along the septal groove. This leaves a platform on the floor of the nose formed by the fractured wall of the vomer and the callus formation. This platform should not be removed but left in its position so that if the dislocated cartilage does not remain in the median line it can again rest on this platform and will not fall to the nasal floor. This callus is usually on a plane lower than the inferior turbinate and seldom interferes with its function. The amount of obstruction which it causes is usually negligible. A Simpson or similar nasal packing is introduced into each nostril and removed from the concave side within twenty-four hours and from the convex side within forty-eight hours to relieve pressure edema.

In a fair percentage of cases in young children this simple closed method of reduction under light anesthesia results in at least partial correction of the old dislocation of the septal cartilage, which will tend to reestablish normal nasal function and ventilation to the accessory sinuses and will aid in the normal development of the nose, jaws, teeth and face.

4. Open Method or Combined Open and Closed Methods: Should reduction by the closed method not give the desired results, it will be necessary to employ the open method or a combination of the open and closed methods. This is the usual procedure in children after about the tenth year. For this type of case I have devised an operation known as "replacement of the lower end of the dislocated septal cartilage versus submucous resection of the dislocated end of the septal cartilage." [2]

I have performed this anatomic restoration in young children during a period of fifteen years and have made the following observations: (*a*) None of the septal cartilage is removed. (*b*) In about from 80 to 85 per cent of the young children operated on the reset lower end of the dislocated septal cartilage remains in the anatomic or near-anatomic position. (*c*) Good nasal function is reestablished. (*d*) Normal ventilation is restored to the nasal accessory sinuses and through the eustachian tubes to the middle ear and possibly to the mastoid cells. (*e*) There is slight or no deformity of the nasal tip. (*f*) There results an improved or normal development of the nose, jaws, teeth and face. (*g*) The lowered nasal tip is raised, reestablishing the normal perpendicularity to the lower end of the cartilaginous septum—a factor on which normal nasal function depends.

10515 Carnegie Avenue.

# USE OF EXTRACT OF NASAL MUCOSA IN TREATMENT OF ACUTE AND CHRONIC RHINOSINUSITIS

## A PRELIMINARY REPORT

NOAH FOX, M.D.

AND

JOHN W. HARNED, M.D.

CHICAGO

In the spring of 1931, during investigations of water-soluble extracts of human nasal and sinus mucosa, an exhilarating effect was observed in patients suffering from chronic disease of the sinuses who were given injections of this material. Not only did the local condition improve decidedly, but the patients experienced a feeling of general well-being. In addition, it was noted that the incidence of colds in these patients was markedly reduced. This phenomenon led to the investigation of the material with regard to its possible curative powers.

The material was prepared by grinding freshly obtained human mucosa with sand, allowing it to extract over night in the cold and filtering and concentrating it to about one fifth of its original volume in an air tunnel. It was then passed through a porcelain filter and injected in 1 cc. doses.

Since the amount of material obtainable was limited, it was not possible to experiment with a large group of patients, but our results were encouraging enough to lead us to believe that possibly by this method a natural antibody was being recovered. We went further and injected the material into rabbits, hoping that any specific antigen that might be present would produce a specific antiserum. The antiserum obtained, however, agglutinated the original antigen only in titers comparable to that noted in the ordinary group agglutination as seen in human and rabbit serums. Further, the local reaction induced by rabbit serum was so severe that this method had to be discarded. A search was made for animal tissues which would be easily obtainable and which possess a natural resistance to infection but which would not be too anticomplementary to human serum. A survey among men expert in

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From the Department of Otolaryngology, the University of Illinois.

This work is being continued at the Armour and Company Laboratories through a grant by Armour and Company.

animal husbandry elicited the information that hogs are probably more resistant to ordinary infections of the head, except tuberculosis, than any other common edible animal. This opinion was based on the observation that hogs rarely suffer from "snotty nose." A visit to a local slaughter-house corroborated this information. In less than a dozen of the five hundred hogs' heads studied was there any pus in the nose or sinuses. On the other hand, almost one third of a like number of sheep showed evidence of nasal infection. The percentage among beeves was very high, though not so high as among sheep. This was fortunate, as nasal and sinus tissue is easily obtained from hogs.

Our work thereafter centered about the fabrication of an extract which would be beneficial both in acute and in chronic infections of the nose and accessory sinuses. Since the nature of the material was unknown, though we believed it to be a protein, we set about to isolate the separate proteins, i. e., euglobulin, pseudoglobulin and serum albumin, and to test them in a large series of cases. However, knowing that most chronic infections will respond favorably for a time at least to the stimulation of almost any foreign protein, it was decided to concentrate our efforts temporarily on acute infections of the upper respiratory tract, i. e., the common cold. As a result of this procedure we had a rapid means of determining the potency of our material. This period of experimentation, which lasted for about a year, was discouraging. In the early stages of a cold, when a severe local reaction developed at the site of the injection, there would frequently occur a brilliant result—the cold would be stopped. However, there was some question whether the sore arm might not be worse than the cold. Apparently a more specific material was necessary, so we decided to investigate the split products of the proteins. With this in mind, the nasal tissues were digested both with pepsin and with trypsin, and the end-products were used for injection. The local reaction caused by these products of decomposition was no less severe than that previously obtained when the whole protein was used. As the clinical results were not promising, this method also was abandoned.

It was becoming evident that the material we were seeking might be not a protein but possibly a material akin to a hormone and linked up to a protein.

We turned about in our methods of extraction, using the solvents which we knew would denature or destroy the proteins, and hoped that the material we were seeking might remain intact. For the past three years our efforts have been focused along these lines, and we have succeeded in obtaining material which both by injection and orally has shown results which give great promise that some time we may reach our goal.

We are constantly changing our methods of preparing the extract, as we feel our way along in an effort to concentrate the active principle

which we are endeavoring to isolate; so at times batches of material are entirely inert while other batches are active. Each batch is tried on a series of ten patients with an acute cold. By constantly instructing our patients to come in at the beginning of a cold, we have built up among ourselves and a number of collaborating physicians a veritable "cold clientele." The patients cooperate with us enthusiastically; hence we easily find enough patients on whom to test our numerous changes in the preparation. Unfortunately, only a few patients in the early stages of a cold are seen at the dispensary, so that practically all the work must be done on private patients, except for those with chronic colds who are given the material orally for a considerable time. Up to the present almost one hundred and fifty changes have been made in the extract and about two thousand patients have been treated with the material. We have not attempted to keep statistics, since many batches of the material are known to be valueless. However, each batch must be tried. Likewise, the numerous changes made in the chemical composition of our material precludes the publication of any data regarding it. Detailed reports will be made, provided we succeed in finding a specific precipitant for the active principle for which we are seeking.

# Clinical Notes

## CHONDROFIBROMA OF THE TRACHEA

### Report of a Case

E. Trible Gatewood, M.D., Richmond, Va.

Lieutard recorded the first case of tracheal tumor in 1767. Türck is said to have been the first to observe such a tumor in a living subject. Since these observations an increasing number of new growths of the trachea have been reported in the literature. This has been particularly true since the advent of the bronchoscope. However, chondrofibroma is infrequent enough to warrant reporting.

Semon stated that the ratio of laryngeal tumors to tracheal tumors of all types is 100:1. McKenzie is mentioned as having seen only 4 tracheal tumors as compared with 800 new growths of the larynx over a period of twenty-three years (1906-1929). Schmidt studied 2,088 new growths of the upper part of the air passages. Seven hundred and forty-eight were laryngeal growths, and 3 were tracheal. These statements tend to emphasize the fact that there is a comparative infrequency of tracheal growths.

The total frequency of such growths is best summarized by D'Aunoy and Zoeller in their comprehensive paper entitled "Primary Tumors of the Trachea." They stated: "Von Bruns reviewed the literature in 1898 and collected only one hundred and forty-one cases. Krieg continued this review in 1908 bringing the sum to two hundred and one cases." Their search of the literature, extending through 1929, brought the total number of all varieties of primary new growth of the trachea to 351.

Many observers have ascribed the infrequency of tracheal growths to the inactivity and simple structure of the organ. The middle portion is relatively immovable and protected from various forms of trauma; hence the predilection for the extremities. The posterior wall is most frequently elected. This is probably influenced by the richer glandular structure and a consideration of the tracheal lymphatic vessels.

The ratio of recorded tumors according to sex is 2.3 in males to 1 in females. Notwithstanding the enormous number of bronchoscopies that are done, and the number is increasing each year, it cannot be denied that tumors of any variety of the trachea are infrequently encountered. According to a review of the literature by several observers up to 1930, there are only 65 cases of tracheal chondroma, osteoma and chondrofibroma, taken collectively, on record.

#### REPORT OF A CASE

Mr. G. M. S., white, aged 28, an athletic director, was seen at the Johnston-Willis Hospital at 7 p. m. on Aug. 18, 1934. The patient was in a semireclining position, suffering from urgent dyspnea. He was semiconscious and cyanosed. His physician stated that the patient had been under his observation for two or three days with mild dyspnea and hoarseness, which he regarded as asthmatic. Morphine

Fig. 1.—The roentgenogram on the left is a lateral view showing the growth and the low tracheotomy tube. The roentgenogram on the right is a lateral view taken after operation.

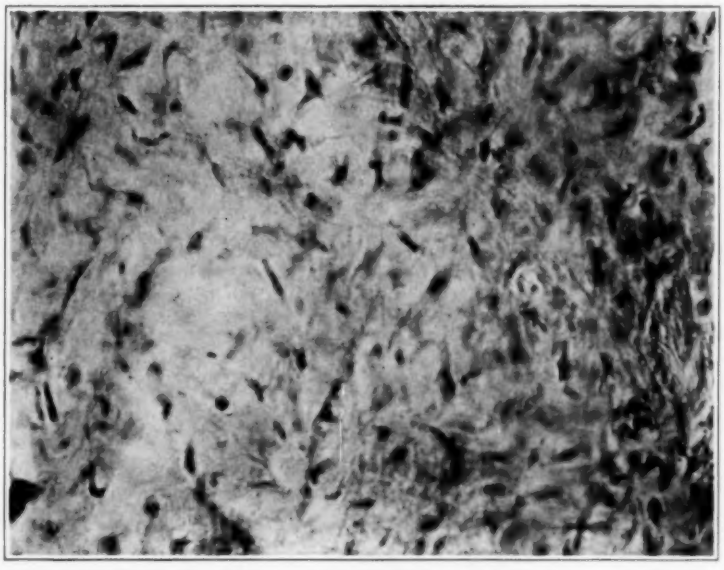


Fig. 2.—A section of the chondrofibroma.

was administered hypodermically at his office that morning, and as there was no improvement in the patient's condition he was removed to the hospital the same day at 3 o'clock. Morphine and epinephrine were administered twice later in the afternoon.

Examination of the patient at 7 o'clock showed a temperature of 97.6 F.; a normal pulse rate and a respiratory rate of 12. There were limited expansion and diminished breath sounds over the entire chest. Laryngeal examination with the patient in a semirecumbent position gave negative results. In view of these findings, it was decided to perform an exploratory bronchoscopy. Passage of the bronchoscope was met immediately by an obstruction which had the appearance of normal mucous membrane. Realizing that a high obstruction of an unknown nature was present, a low tracheotomy was resorted to. This was accomplished without any form of anesthesia, as the patient was then entirely insensible. He soon regained consciousness, with normal respiration.

Examination of the upper portion of the trachea with a laryngeal mirror a few days later, with the patient in an upright position, showed a questionable mass ¾ inch (1.9 cm.) below the vocal chords. The roentgenograms showed a mass apparently attached to the posterior wall of the first and second rings of the trachea. An open operation was decided on, with insufflation-ether anesthesia. A midline incision was made extending from the upper border of the thyroid cartilage to the fourth tracheal ring. The isthmus of the thyroid gland was severed and retracted. The thyroid cartilages of the larynx and the upper rings of the trachea were opened. The vocal chords were carefully separated at their immediate anterior junction. The hard and large cone-shaped mass was dissected from the posterior tracheal wall, which appeared to invade the anterior esophageal lumen and a portion of the cricoid cartilage. After the mass was completely removed, a nasal feeding tube was inserted, and the esophageal defect was sutured. The vocal chords were approximated, and the thyroid cartilages were fixed by suturing the overlapping ribbon muscles to insure even cartilaginous union.

Nine days later the tracheotomy tube was removed, and the tracheotomy opening was closed. Two days later the feeding tube was withdrawn, and the patient resumed the normal way of swallowing with no difficulty. He was discharged twenty days after admission with a normal voice.

Histologic study of the growth by Dr. W. A. Shepherd showed dense fibrous tissue with small areas of cartilage and calcification. At the operation gross examination showed the growth to be mainly cartilage, covered and interspersed with dense fibrous tissue, resembling a chondrofibroma.

## COMMENT

Symptoms of a tracheal new growth may, in certain instances, be confused with those of a bronchial or pulmonary lesion.

New growth of cartilaginous origin is extremely rare.

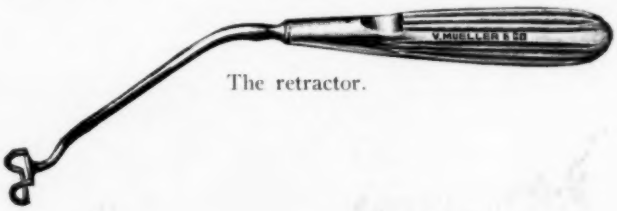
The case reported here emphasizes the serious mistake of administering morphine to certain patients with dyspneic tendencies.

Professional Building.

## TONSIL PILLAR RETRACTOR

D. H. Anthony, M.D., Memphis, Tenn.

I have used the retractor shown in the accompanying illustration for two years and have found it useful as an anterior pillar retractor after tonsils are removed and the retractor turned up in the upper pole. It holds the fossa open at the top to facilitate the ligation of bleeding vessels at the top of the fossa. The shaft of the instrument is bent at an angle, so as not to obstruct the operator's view.




The retractor.

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## METASTASIS TO THE PETROUS APEX FOLLOWING CARCINOMA OF THE BREAST

Herman Rubin, M.D., Brooklyn

A woman aged 48 was admitted to the hospital on April 14, 1934, with a history that she had suddenly collapsed while going to bed, the right leg having given way. The previous history was unimportant save that the patient had a radical mastectomy at another hospital about two years previously for carcinoma of the left breast.

Examination revealed a fracture of the right femur at the junction of the upper and the middle third. Roentgen examination showed this fracture to be due to a metastatic deposit in the bone. Further examination showed several small nodules in the skull, complete paralysis of the left side of the face and palpable glands in the left axilla and in the supraclavicular region.

Ten days after admission to the hospital the patient complained of pain in the left ear and on the left side of the head. There was a moderate amount of serosanguineous discharge from the ear, and the hearing was considerably diminished. In the anterior portion of the drum was a small reddish granulomatous area which bled when touched with a probe. Complete paralysis of the left facial nerve, anesthesia of the cornea and loss of sensation in all the branches of the fifth nerve on the left side were noted. Douching the left ear revealed a diminished reaction from the vertical canal and a normal reaction from the horizontal canal with the Kobrak method. Hearing was present in the left ear with the Bárány apparatus in the opposite ear.

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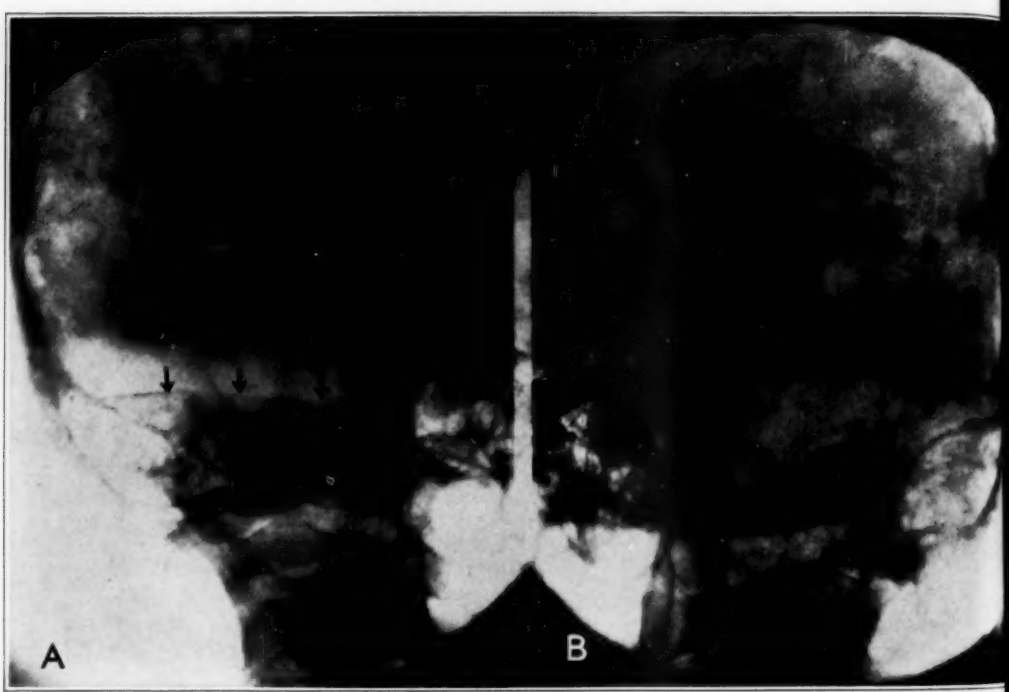
From the Otolaryngologic Service of Dr. M. C. Myerson, Kings County Hospital.

Roentgen examination of the petrous pyramid with the patient in the Stenver position showed an almost complete destruction of the apex, from the labyrinth to the tip, with metastatic deposits in the skull and mastoid and destruction of the plate over the lateral sinus.

Five weeks later examination showed involvement of the sixth nerve in addition to that of the fifth and seventh cranial nerves. The patient could not move the left eye outward. Hearing was still present in the left ear.

Ten weeks after the patient's admission to the hospital the left ear still showed a discharge. A reddish polypoid mass, springing from the anterior part of the drum, was thought to be a metastatic deposit breaking through in the region of the eustachian tube from the apex of the petrous pyramid. With the Bárány apparatus in the right ear the patient could not hear a loud shout.




*A* shows preservation of the line on the anterior surface of the petrous pyramid with the patient in the Stenver position. *B* shows complete absence of structural detail in the petrous pyramid, due to infiltration with metastatic adenocarcinoma. The superior semicircular canal is eroded. The outline of the horizontal semicircular canal can be seen.

Twelve weeks later the drum was bulging, apparently pushed out by a mass behind it. Examination of a biopsy specimen from this mass was reported by Dr. Hala as revealing adenocarcinoma. Douching the ear with cold water caused no reaction from either the vertical or the horizontal semicircular canal. The sound of the tuning forks was lateralized to the opposite side, and no hearing was present. Roentgen examination showed destruction of the entire apex of the petrous pyramid, in addition to destruction of the superior semicircular canal.

The patient died one year and two weeks after admission to the hospital, more than three years after an operation on the breast. During that time there was no extension of the growth to the nasopharynx, nor was there any involvement of the ninth, tenth, eleventh or twelfth cranial nerve, showing that the area of the jugular foramen was free.

COMMENT

This patient had a metastasis to the petrous portion of the temporal bone following carcinoma of the breast. At first involvement of the seventh and fifth cranial nerves was noted, indicating that there was a destructive process along the anterior surface of the petrous pyramid, followed by a breaking through in the region of the eustachian tube. Later, this condition extended along the surface with involvement of the sixth nerve. Next there was destruction in the region of the superior semicircular canal, as evidenced by the loss of reaction to douching and by roentgen examination. The horizontal canal later became destroyed. Biopsy showed the granulomatous condition in the middle ear to be due to adenocarcinoma, the same condition as had been present in the breast. Permission for an autopsy was not obtainable.

277 Eastern Parkway.

# Progress in Otolaryngology

## Summaries of the Bibliographic Material Available in the Field of Otolaryngology

## TUMORS OF THE NOSE AND THROAT

GORDON B. NEW, M.D.
ROCHESTER, MINN.
AND
WALTER KIRCH, M.D.
DES MOINES, IOWA

### TUMOR OF THE NOSE AND SINUSES

Price [1] reported 13 cases of malignant tumor of the maxillary sinus and discussed malignant growths arising from the mucosa of the nasal fossae and accessory nasal sinuses. It is noteworthy that the prognosis was uniformly bad, regardless of the type of tumor. The author stressed the difficulty of diagnosis because of the late appearance of symptoms directly referable to the site of involvement. When possible, Broders' grading of malignant growths was adopted, but apparently with an erroneous conception, as a squamous cell epithelioma of the antrum with malignant course and multiple and extensive metastases was classified as grade 1.

Watson-Williams [2] reported 13 cases of carcinoma of the ethmoid cells and maxillary sinus. In cases in which the maxillary sinus was involved it was opened surgically, and radium needles were inserted. In the treatment of ethmoid tumor, needles were inserted through the skin, along the lamina papyracea and the wall of the orbit and directly into the orbit. Needles were also inserted into the nasal cavity and were supported with a silver framework. Nine of 10 patients who were treated had remained well for from ten months to six years. One patient who remained well five years could not be traced later. Roentgen therapy was used in cases of lymphatic involvement, which always occurs late in these cases.

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From the Section of Laryngology, Oral and Plastic Surgery, the Mayo Clinic.

1. Price, W. L.: Malignant Tumours of the Nasal Mucosa, J. Laryng. & Otol. **50**:153 (March) 1935.

2. Watson-Williams, E.: Cancer of the Nasal Accessory Sinuses, with Reports of Thirteen Cases, Practitioner **133**:717 (Dec.) 1934.

### TUMOR OF THE NASOPHARYNX

Cappell [3] studied 12 cases of malignant tumor of the nasopharynx, pharynx and tonsil. He accepted, on the basis of his histologic investigation, the new entity lympho-epithelioma. The tumors in his cases corresponded in part to the tumors described by Regaud and in part to those described by Schmincke, which led him to state that the two types reported by these authors are merely variations of the same tumor. He expressed the opinion that the transitional cell epithelioma is at least closely related to lympho-epithelioma. Excellent photomicrographs were presented. The article is too technical for brief synopsis.

### TUMOR OF THE PHARYNX

A new approach was devised for the removal of carcinoma of the tonsil and neighboring regions with the use of diathermy, and the method was put into practice by Macpherson.[4] The first stage of the operation consists in ligation of the external carotid artery; this is followed in two weeks with exposure of the growth through an incision made in the median line of the neck. Half of the hyoid bone is removed; the hyoid muscles are retracted laterally, and the growth is then destroyed with the use of diathermy. The wound is closed by replacing the shifted parts, and a drain is left in the lower part of the wound.

Garland [5] reviewed the early results in 14 cases of carcinoma of the pharynx and in 10 cases of carcinoma of the larynx in which roentgen therapy was employed with a modification of the Coutard technic. In 7 of the cases of carcinoma of the pharynx the clinical progress of the lesion was arrested, and in 2 of these instances the patients remained well. In the other 7 cases of carcinoma of the pharynx the patient was improved but the progress of the lesion was not arrested. In 4 of the cases of carcinoma of the larynx the patient was cured, and in 6 cases improvement was temporary. The author stated that the degree of differentiation of the growth does not aid in determining the radiosensitivity of the tumor. He outlined in tabular form the Coutard technic and its modifications by various well known radiotherapists. In another table he compared the results obtained in this type of malignant disease with operation and those obtained with radiotherapy; the results appeared to be slightly more favorable in the cases in which

3. Cappell, D. F.: On Lympho-Epithelioma of the Nasopharynx and Tonsils, J. Path. & Bact. **39**:49 (July) 1934.

4. Macpherson, Duncan: Operation for the Removal of Carcinoma of the Faucial Tonsil and Contiguous Parts, Ann. Otol., Rhin. & Laryng. **43**:727 (Sept.) 1934.

5. Garland, L. H.: The Treatment of Carcinoma of the Pharynx and Larynx, Radiology **24**:261 (March) 1935.

the condition was treated with irradiation. In the early stage of intrinsic carcinoma of the larynx the percentage of cures was found to be about the same with the two procedures, but the author considered irradiation to be the preferred method because of the low mortality and the better cosmetic and functional results.

Martin and McNattin [6] described the method of roentgen therapy in use at the Memorial Hospital since 1931 in the treatment of carcinoma of the pharynx and tonsil and extrinsic carcinoma of the larynx. This method, a modification of the Coutard technic, was used in 140 cases during 1931 and 1932. In 41, or 29 per cent, of these cases the patients had remained well for from eighteen to thirty months. Radon seeds were used in order to apply additional radiation to lymph nodes which were the site of metastatic involvement. The authors, like Coutard, noted that the percentage of cures was higher in females than in males. They did not find that the histologic type influenced the prognosis as much as they expected. At the time of writing they combined the use of divided doses of roentgen radiation with interstitial implantation of radon seeds.

Zuppinger and Stewart-Harrison [7] reported their results in the treatment of 150 patients with malignant tumor of the pharynx and larynx. One hundred and forty-four cases which had previously been reported were included. The patients were observed for from two and a half to five years after treatment. All patients were accepted for treatment, no matter how advanced the lesion. Local healing of the growth was obtained in 53 per cent of the cases, relative healing in 26 per cent and complete healing for a period of twenty-seven months in 17 per cent. The experience of these authors led them to modify to some extent the protracted-fractional method of roentgen therapy, which they considered to be the method of choice for all malignant conditions of the pharynx and for practically all types of malignant tumor of the larynx. Radical operation was advised in some cases of malignant tumor of the larynx.

Stewart-Harrison and Sarasin [8] described their modification of the protracted-fractional method of roentgen treatment of malignant disease of the pharynx and larynx. The effect of this type of treatment on the epidermis, dermis, mucosa, submucosa and supporting tissues, as well as on the growths of various histologic types, was described. The

6. Martin, H. E., and McNattin, R. F.: The Treatment of Cancer of the Pharynx, Tonsil and Extrinsic Larynx by Divided Doses of External Radiation, Am. J. Roentgenol. **32**:717 (Dec.) 1934.

7. Zuppinger, A., and Stewart-Harrison, R.: Malignant Disease of the Larynx and Pharynx (Second Communication), J. Laryng. & Otol. **49**:720 (Nov.) 1934.

8. Stewart-Harrison, R., and Sarasin, R.: Malignant Disease of the Larynx and Pharynx (Third Communication), J. Laryng. & Otol. **50**:233 (April) 1935.

authors stressed the necessity of adapting the treatment not only to the type of tumor and its situation but to the individual patient. They advised variation of the treatment day by day in each case. They noted that infection and infiltration, even more than the lack of differentiation of the tumor, influence the results of treatment unfavorably. They observed the beneficial effect produced on the skin by infra-red radiation. They also found that short wave diathermy was of great assistance in maintaining the healthy condition of the supporting tissues. Infra-red therapy diminished pain and discomfort, improved the general condition of the patient and reduced the danger of complications, such as necrosis.

Duffy [9] reported 176 cases of carcinoma of the tonsil observed at the Memorial Hospital in the ten years from 1919 to 1929. The patients were treated with external irradiation combined with implantation of radon. At present, a modified Coutard technic is used in combination with interstitial implantation of radon in cases in which there are residual nodules. Lymph nodes which are the site of metastatic involvement are removed surgically, if possible, unless the primary growth has been classified as transitional cell epithelioma or lympho-epithelioma. The author classified the tumors on a histologic basis as squamous cell and transitional cell carcinoma, grades 1, 2 and 3. It was of interest to note that in 72 per cent of the cases the malignant growth was of grade 2. Thirty-two, or 18.1 per cent, of the patients remained clinically well three years or more.

Schall [10] reported the results of treatment in 230 cases of carcinoma of the tonsil at the Collis P. Huntington Memorial Hospital, from 1918 to 1934. In 88.7 per cent of these cases the patients were males. Metastasis or extension of the lesions to other regions occurred in 212 cases. Treatment was completed in 118 cases; 22 of the patients were still living, without recurrence, at the time of writing, and some of these patients had lived twelve years after treatment. Clinical improvement was obtained, at least temporarily, in almost all the cases. All kinds of treatment were tried: surgical and electrosurgical intervention and irradiation. The preferred method in use at the time of writing consisted in external irradiation with the Coutard method, which was combined, when indicated, with interstitial implantation of radon.

New and Figi [11] reported 91 cases of primary malignant growth of the antrum. Thirty, or 40 per cent, of the patients remained well five

9. Duffy, J. J.: Carcinoma of the Tonsil: Clinical Study of One Hundred and Seventy-Six Cases with Histologic Diagnoses, New York State J. Med. **34**: 865 (Oct. 15) 1934.

10. Schall, L. A.: Carcinoma of the Tonsils: A Statistical Study of Two Hundred and Thirty Cases, New England J. Med. **211**:997 (Nov. 29) 1934.

11. New, G. B., and Figi, F. A.: Malignant Diseases of the Mouth, Pharynx and Larynx: Five Year Cures, Surg., Gynec. & Obst. **60**:483 (Feb.) 1935.

years or more after treatment. Twenty-three, or 50.4 per cent, of patients with secondary malignant involvement of the antrum remained well five years or more. Of 76 patients with malignant tumor of the pharynx and tonsil 44, or 57.9 per cent, remained well five years or more. Of the 34 patients who were subjected to thyrotomy 28, or 82.3 per cent, were well, and of 73 patients who were subjected to laryngectomy 41, or 56.1 per cent, remained well five years or more after operation.

Kramer [12] reported a case in which fibrolipoma arose at various times in the hypopharynx and esophagus. The first growth arose from the arytenoid cartilage and was removed without recurrence. The second had its origin on the posterior surface of the cricoid cartilage, and this growth also was removed without recurrence. A third tumor was developing on the right side of the upper third of the esophagus at the time of writing. Similar cases have been reported in the literature.

Thirty-one cases of epithelioma of the nasopharynx, pharynx, tonsil and larynx occurring during 1931 and 1932, in which the patients were treated with a modification of the Coutard technic, were reviewed by Lenz, Coakley and Stout.[13] The authors emphasized principally the necessity of a maximal dose, if satisfactory results are to be obtained, and the importance in the final result of the determination of the histologic type. It was found that in 14 cases in which the course of the disease was arrested for periods varying from nine to twenty-four months the tumor had previously been classified as radiosensitive, while the great majority of the rest of the tumors which reacted unfavorably to treatment had been classed as radioresistant. This classification was based on the usual histologic criteria. Infection and infiltration, especially into the cartilages, were found to interfere with successful treatment. Tracheotomy was not observed to have any unfavorable effect on the course of the treatment. The authors concluded that this method of treatment warranted further application.

### TUMOR OF THE LARYNX

Kramer and Som [14] reported a case of recurrent primary amyloid tumor of the larynx. These growths were removed with the use of suspension laryngoscopy. On the basis of a review of the literature, the authors divided amyloid deposits of the upper air passages into

12. Kramer, Rudolf: Multiple Fibrolipomata of the Hypopharynx and Esophagus, Ann. Otol., Rhin. & Laryng. **43**:881 (Sept.) 1934.

13. Lenz, M.; Coakley, C. G., and Stout, A. P.: Roentgen Therapy of Epitheliomas of the Pharynx and Larynx, Am. J. Roentgenol. **32**:500 (Oct.) 1934.

14. Kramer, Rudolph, and Som, M. L.: Local Tumor-Like Deposits of Amyloid in the Larynx: Report of a Case with Review of the Literature, Arch. Otolaryng. **21**:324 (March) 1935.

four groups: (1) deposits which occur secondarily in a preexisting tumor or at the site of chronic inflammation; (2) deposits which form part of generalized amyloidosis of the usual type; (3) deposits which occur in generalized amyloidosis of atypical character situated in organs not usually affected in the typical form and are not associated with chronic suppuration, and (4) deposits which occur primarily in a certain anatomic region and are limited to this region, or idiopathic tumor with no known etiologic factor. The fourth group was of primary interest to the authors. The chief characteristics of tumors belonging to this group are multiplicity, involvement of contiguous parts, transparent, waxy appearance and absence of ulceration, lymphatic involvement and pain. The authors found 95 reports of this type of tumor in the literature. In a large majority of the cases the larynx was the organ involved. Tumor of the tongue and trachea was next in frequency of occurrence. Symptoms are slow to appear, the most prominent resulting from pressure, which produces hoarseness. On examination the appearance is characteristic, but exact diagnosis is difficult without biopsy. An interesting addition to the diagnostic equipment is the use of vital staining with congo red, which shows a predilection for tissue of this type. This stain is not only of aid in diagnosis but of great value in the outlining of the region of involvement at the time of extirpation. Radical removal by excision or the use of diathermy was found to be the treatment of choice. Irradiation and liver therapy are yet of uncertain value.

Birkett [15] described a case in which lipoma of the larynx arose from the tissue beneath the mucosa of the false vocal cord. This was removed through an incision in the midline of the neck; it was not necessary to open the larynx. Only 5 other cases of intrinsic lipoma of the larynx and 42 cases of lipoma of extrinsic origin have been described in the literature.

New [16] reported 2 cases of sarcoma of the larynx in which the patients were treated in 1934 by means of operative procedure. In 1 of the cases a pedunculated fibromyxosarcoma, grade 4, was removed through a thyrotomy incision, and in the other case a large chondrosarcoma, grade 2, was removed by means of curettage, through a similar approach. New stated that sarcoma of the larynx is, on the whole, clinically benign, as compared with carcinoma. When the tumor is large, he advised preliminary tracheotomy, followed by thyrotomy and the use of surgical diathermy and irradiation.

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15. Birkett, H. S.: Lipoma of the Larynx—Intrinsic in Origin, J. Laryng. & Otol. **49**:733 (Nov.) 1934.

16. New, G. B.: Sarcoma of the Larynx: Report of Two Cases, Arch. Otolaryng. **21**:648 (June) 1935.

Webster [17] reported his experience since 1922 in the treatment of carcinoma of the larynx with roentgen radiation. Forty-two cases were reported. The author described the gradual evolution of the technic employed as new and better methods were discovered. He concluded that the greatest promise is shown by the Coutard protracted-fractional method, which he employed in the last 2 cases in his series. In both these cases the lesion was advanced but the patient had remained well more than six months after treatment. The most interesting part of the article is the brief, but detailed, description of this method and the explanation of the theoretical and experimental reasons for its adoption.

Beck and Guttman [18] reviewed briefly their experience in the treatment of more than 500 patients with malignant tumor of the larynx. They classified all growths involving the posterior third of either the true or the false vocal cords as extrinsic in respect to operative treatment. They again stressed the necessity for training both the medical profession and the laity to consider hoarseness as a symptom which should arouse suspicion of cancer. In almost 75 per cent of the cases in their series the lesion was already inoperable when the patient was first seen. They found that operation, whenever possible, offered the best results. Twenty-one of 22 patients on whom laryngofissure was performed with a slight modification of the St. Clair Thomson technic remained well from two to thirteen years after the operation. Fifty-one of 86 patients on whom complete laryngectomy was performed with the MacKenty method were free from recurrence for more than five years. One patient died as a result of operation. In the cases in which the tumor was adjudged inoperable, the authors found that the most satisfactory results were obtained with the Coutard technic or with the use of large (4 Gm.), heavily screened radium packs. After one of their patients became impatient with the use of an artificial voice box and had produced a fistulous tract between the upper margin of the tracheal opening and the hypopharynx by means of a curved ice-pick heated red-hot, as a result of which a satisfactory voice was produced when the tracheal opening was closed with the finger, the authors attempted, in several cases, to produce a communication between the trachea and the hypopharynx by means of an appropriate diathermy electrode; as yet the results have not been determined.

Salinger [19] discussed the surgical treatment of carcinoma of the larynx. His paper presents a brief but comprehensive review of the

17. Webster, J. H. D.: The Protracted-Fractional X-Ray Method (Coutard) in the Treatment of Cancer of the Larynx, J. Laryng. & Otol. **49**:429 (July) 1934.

18. Beck, J. C., and Guttman, M. R.: Carcinoma of the Larynx—Some Conclusions Derived from Personal Experience, Laryngoscope **45**:163 (March) 1935.

19. Salinger, S.: Carcinoma of the Larynx: Surgical Considerations, Laryngoscope **45**:174 (March) 1935.

opinions of the leading laryngologists as to indications for operation, prognosis and surgical technic.

Hirsch and Baum [20] reported 13 cases of squamous cell carcinoma of the larynx, in 4 of which the growth was classed as intrinsic and in 9 as extrinsic. The patients were treated from 1929 to 1932 with a modified Coutard technic. Five patients had remained well for varying periods, although the growths were in an advanced stage when first observed. A careful review of the surgical statistics compiled by the leading laryngologists indicates that in the treatment of an intrinsic laryngeal growth irradiation is to be preferred to operation because of the lower mortality, the better functional results and an equal percentage of cures. In extrinsic growth irradiation was declared to be the method of choice. The importance of roentgenoscopic and roentgenographic examination in the accurate diagnosis of the site and extent of the growth was stressed. It was advised that whenever tracheotomy is believed to be necessary, it should be performed, if possible, before roentgen treatment is instituted and that the cannula should be removed during treatment to avoid secondary irradiation due to the metal. The author's criterion for the dose of roentgen radiation was based on complete destruction of the mucous epithelium.

### TUMOR OF THE TRACHEA

Stenn [21] reported a case of carcinoma of the trachea, with perforation into the esophagus, and reviewed the recent literature.

Simpson and Moore [22] reported a case which they believed to be the only instance of adenocarcinoma of the trachea with colloid degeneration. On the basis of a brief review of the literature, they concluded that dyspnea, which simulates asthma and is associated with occasional postural variations and apparent good health, and the absence of thoracic signs are the characteristic symptoms of a growth in this region.

Richards and Dietrich [23] reported a case which they believed to be the first instance of true fibrosarcoma arising in the wall of the trachea. Another unusual feature in their case was the age of the patient, a Negro girl only 8 months old. Tracheotomy was performed three times

20. Hirsch, I. S., and Baum, S. M.: The Evaluation of the Roentgen Treatment of Laryngeal Carcinoma: Report of Cases, Radiology **24**:281 (March) 1935.

21. Stenn, Fred: Carcinoma of the Trachea: Review of Recent Literature and Report of a Case, Arch. Otolaryng. **21**:190 (Feb.) 1935.

22. Simpson, W. L., and Moore, R. M.: Primary Colloid Adenocarcinoma of the Lower Third of the Trachea, Ann. Otol., Rhin. & Laryng. **43**:1133 (Dec.) 1934.

23. Richards, L. G., and Dietrich, H. F.: Fibrosarcoma of the Trachea, Ann. Otol., Rhin. & Laryng. **43**:892 (Sept.) 1934.

for the relief of acute obstruction of the respiratory tract. Bronchoscopic examination failed to reveal the cause of the obstruction, which was not discovered until necropsy.

### TUMOR OF THE ESOPHAGUS

Lewis [24] reported the surgical removal of a section of the cervical and the upper part of the thoracic portion of the esophagus in the treatment of carcinoma. The patient died of hemorrhage five weeks later. The author described the approach, which he considered comparatively simple, and stated that this operation should be tried in selected cases.

Hudson [25] reported 4 cases in which surgical intervention was employed in the treatment of carcinoma of the esophagus. In 3 of these cases, in which the growth involved the middle third of the esophagus, the transthoracic route was employed; in the fourth case, in which the growth involved the upper third of the esophagus, the resection was performed through an incision along the anterior border of the sternocleidomastoid muscle. While all the patients died, of various causes, the author expressed the belief that the surgical problem involved is capable of satisfactory solution.

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24. Lewis, F. O.: Resection of the Cervical and Upper Thoracic Esophagus for Carcinoma: Report of a Case, Ann. Otol., Rhin. & Laryng. **43**:1192 (Dec.) 1934.

25. Hudson, W. A.: Carcinoma of the Esophagus: Its Diagnosis and Treatment, Ann. Otol., Rhin. & Laryng. **43**:1198 (Dec.) 1934.

# News and Comment

## AMERICAN BOARD OF OTOLARYNGOLOGY

An examination was held in Kansas City, Mo., on May 9, 1936, during the meeting of the American Medical Association. Forty-three candidates were examined, of which number thirty-four were passed and nine were conditioned or failed. The board desires to announce that hereafter examinations will be of two days' duration and will include written as well as oral tests. Furthermore, after Jan. 1, 1938, no certificate will be granted "formally," that is, without examination, and all candidates shall take the examination in pathology. An examination will be held in New York on September 25 and 26, just prior to the meeting of the American Academy of Ophthalmology and Otolaryngology. Application blanks may be secured from the secretary, Dr. W. P. Wherry, 1500 Medical Arts Building, Omaha.

# Abstracts from Current Literature

## Ear

EAR EXOSTOSES. A. HRDLIČKA, Smithsonian Misc. Collect., vol. 93, no. 6, 1935.

Exostoses of the ear are localized hyperplasias or outgrowths, arising from essentially the tympanic part—but occasionally also from the squamous portion—of the external bony meatus. They arise generally from what were the free upper ends of the tympanic ring. Their development belongs chiefly to the latter adolescent period and the earlier half of the adult period. A predisposition to exostoses of the ear is now probably universal in man, but in some races or groups the formation of the abnormalities, owing perhaps to direct hereditary effects, is much more frequent than in others. Males are considerably more subject to the growths than females, and the well-to-do (among the whites at least) more than the poor. The abnormality is most frequently bilateral; when one-sided, it occurs somewhat more commonly in the left than in the right ear. Structurally, the growths range from cancellous to compact, without any definite segregation. Though macroscopically the bone is often more or less aberrant, its elements are normal and remain visible. There is never any breaking down or necrosis, nor is there complete calcification. The causes are systemic or predisposing and exciting. The paramount systemic cause appears to be a deranged neurovascular control of the parts involved, chiefly the tympanic bone, during what corresponds to the sexually more active part of life; but on critical consideration it becomes apparent that no connection of the exostoses with sex activity can be ascertained. What causes the peculiar time-limited neurovascular derangement that predisposes or leads to exostoses of the ear cannot yet be definitely established, but it appears to be something in the hereditary endowment of the trophic nerve centers that control the normal status of the external bony meatus. A deranged accommodation of evolutionary nature suggests itself, rather than degeneracy, as a plausible explanation. The exciting cause of such exostoses, when the predisposition to these exists, may be anything mechanical or chemical that produces prolonged irritation, with consequent hyperemia progressing to inflammation, of any part of the bony meatus.

FROM THE AUTHOR'S SUMMARY. [ARCH PATH.]

TREATMENT OF OTOSCLEROTIC AND SIMILAR TYPES OF DEAFNESS BY THE LOCAL APPLICATION OF THYROXINE. A. A. GRAY, J. Laryng. & Otol. **50**:729 (Oct.) 1935.

Gray observed that when thyroid extract is applied locally to the mucous membrane of the nose it produces an active congestion without inflammatory reaction which lasts for a long time. If otosclerosis is the result of a defective vasomotor response in the small blood vessels of the ear, thyroxine applied locally might overcome the defect. He treated fourteen patients, and considerable improvement resulted in seven. In four of the seven patients, tinnitus was greatly relieved. Wax began to be secreted again. The subjective symptom of paracusis is no contraindication to this treatment. Anesthesia of the tympanic membrane was obtained by instilling from 15 to 20 drops of a solution of 10 parts of cocaine hydrochloride dissolved in 90 parts of aniline. It is important after the drops have been in the meatus for five minutes, to dry out carefully all the aniline and cocaine solution with cotton-wool pledgets. If this is done, there need be no symptoms of aniline poisoning. Once a week Gray injected $\frac{1}{128}$ grain (0.0005 Gm.) of thyroxine suspended in 4 minims (0.24 cc.) of distilled water through the tympanic membrane into the inner middle ear by means of an ordinary hypodermic syringe. The administration was painless. A slight feeling of giddiness was frequently present immediately after the injection, but this passed off in a minute

or two. In only one case was there an inflammatory reaction following the procedure, and that was not due to the injection of thyroxine. A large number of patients with otosclerosis and dry catarrh of the middle ear can be greatly improved in regard to hearing and tinnitus by the intratympanic injection of thyroxine. Those in whom the disease is in its latest stages do not respond to the treatment. It is not yet possible to say how often the treatment may have to be repeated. When the improvement occurs it lasts in some cases for several weeks, but sooner or later the effects must be expected to pass off.

EDITOR'S ABSTRACT.

A CASE OF MULTIPLE SCLEROSIS WITH EXCLUSION OF THE LABYRINTH. IDA SILBERPFENNIG, Rev. d'oto-neuro-opht. **12**:571 (Sept.-Oct.) 1934.

Exclusion of the auditory nerve in cases of multiple sclerosis has been known for a long time. Beck has observed a number of cases of sudden transitory deafness and exclusion of the labyrinth in one or both ears, which disappeared either completely or partially after a time. Isolated transitory exclusion of the labyrinth has been rarely observed.

The patient, aged 30, complained of vertigo and headache and exhibited paralysis of movement of the eyes to the right, vertical nystagmus on attempting to look to the right, horizontal nystagmus to the left and an intact cochlear nerve. There was no reaction on stimulation of the left labyrinth. There was absence of the quick phase of horizontal nystagmus toward the right and of optokinetic nystagmus to the right. After two weeks the paralysis had almost disappeared, both labyrinths were hypersensitive, and optokinetic nystagmus was absent. A provisional diagnosis of lesion of the posterior longitudinal bundle around the nucleus of the external motor oculi was made.

As the voluntary pathway to the nuclei of the oculomotor nerves are very near the central pathway from the labyrinth in the posterior longitudinal bundle, it is striking that paralysis of gaze to the right due to pontile involvement was not accompanied by symptoms of a disturbance of the right labyrinth. Brunner explained this phenomenon by the fact that in a partial injury of the posterior longitudinal bundle voluntary ocular movements suffer much sooner than the reflex movements from the labyrinth. This does not mean that the fibers conducting the labyrinthine impulses remain intact while the voluntary fibers are injured; labyrinthine irritation affects the ocular movements differently and apparently more intensively than does the voluntary impulse. Spiegel and Tokay, after splitting the posterior longitudinal bundle on one side, could still provoke movements of the eyes by rotatory stimulation of the labyrinth but not by faradic stimulation of the cortex. The group of symptoms in the cases reported could all be explained by a single lesion in the posterior longitudinal bundle; their transitory character supports this assumption.

DENNIS, Colorado Springs, Colo. [ARCH. NEUROL. & PSYCHIAT.]

RESPIRATORY FUNCTIONS OF THE EUSTACHIAN TUBES. F. LASAGNA, Arch. ital. di otol. **47**:665 (Oct.) 1935.

Lasagna describes the method by which he proved that air passes continuously through the eustachian tubes and that its ingress is synchronous with inspiration. He states that the eustachian tubes are kept permanently patent and convey air into the middle ear, to which they are what bronchi are to the lungs. He maintains that both from the anatomic and from the physiologic point of view the eustachian tubes are a part of the respiratory tract.

EDITOR'S ABSTRACT.

MORPHOLOGY AND HISTOLOGY OF THE PISCINE LABYRINTH. A. DENKER, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **139**:321, 1935.

Denker points out that the labyrinths of fishes have been studied again and again, in order to determine whether fishes can hear. The chief reason for these

studies was that fishes have no papilla basilaris, without which hearing is impossible in terrestrial animals and in man. He studied the labyrinths of various teleostomes (fresh water bony fishes) and chondropterygians (cartilaginous fishes). Before giving his descriptions of the labyrinths, he points out that fishes have neither an external nor a middle ear, except that in the ostariophysi there exists an apparatus (Weber's apparatus) that can be compared with the chain of ossicles in the higher vertebrates. Then, after calling attention to the comparatively large size of the piscine labyrinth, he describes his observations on the labyrinth of a brook trout (Salmo fario) and on that of a golden orf (Idus melanotus variatio auratus). He found considerable similarity between the labyrinths of these two species, but they differed in the presence of Weber's apparatus in the golden orf and in other details. He further reports his studies on chondropterygians, that is, on two types of sharks (Mustelus vulgaris and Selache maxima). In these two types he again found considerable similarity. However, the membranous labyrinth differed in the two species in that in Selache maxima the ampullae of the semicircular canals do not enter directly into the utriculus but are connected with it by a tube. In comparing the labyrinth of the bony fishes with that of the cartilaginous fishes, Denker detects similarities as well as differences. In both types there are a pars superior with three semicircular canals and a utriculus and a pars inferior with the sacculus and the lagena. The number of nerve terminals is likewise the same (three cristae, the macula of the recessus utriculi, the macula of the sacculus, the macula of the lagena and the papilla neglecta) in all of the examined specimens. However, there is a considerable difference in the capsule that surrounds the membranous labyrinth. In the bony fishes this capsule is incomplete, whereas in the cartilaginous fishes a strong capsule surrounds the membranous labyrinth. As regards the utriculus and the sacculus, the topography is more complicated in the cartilaginous than in the bony fishes. After calling attention to differences in the otoliths, he cites the results of the researches of von Frisch according to which the macula utriculi serves the preservation of the equilibrium, whereas the macula sacculi and perhaps also the macula lagenae serve auditory perception.

EDITOR'S ABSTRACT.

EFFECT OF STIMULATION OF THE LABYRINTH ON HEART ACTION. T. HASEGAWA, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **139**:383, 1935.

Hasegawa points out that whereas Spiegel reached the conclusion that a disturbance of the labyrinth exerts no reflex action on the heart, Nishikori and Toda observed signs of stimulation in the electrocardiogram after stimulation of the labyrinth by means of a cold stimulus. For this reason, he decided to study the influence exerted by the labyrinth on the exposed heart. He made his experiments on rabbits and found that caloric or pressure stimulation of the labyrinth produced reflex changes in the heart's action. That these changes were due to the disturbances of the labyrinth is proved by the fact that they were absent when the stimulus was applied on the side on which the labyrinth had been removed, but present when the intact side was stimulated.

EDITOR'S ABSTRACT.

CHANGES IN THE LABYRINTHINE CAPSULE OF GUINEA-PIGS AFTER ADMINISTRATION OF PARATHYROID HORMONE. W. KRAINZ, Monatschr. f. Ohrenh. **69**:1025, 1935.

Following introductory remarks about the production of osteitis fibrosa generalisata by the administration of parathyroid hormone, Krainz describes observations on the temporal bones of animals that had been treated with parathyroid hormone. These studies were carried out in order to determine in what manner the labyrinthine capsule responds to the stimulation by the parathyroid hormone, in comparison with other experimental stimulation (dextrose, lead acetate and viosterol) which is also being investigated. The experiments with the parathyroid hormone were made on four different groups of animals, each group

being treated with a different dosage and for a different length of time. The animals of the fourth group, which for sixteen days had received increasing amounts of the hormone and in all had received 350 units, although they showed considerable changes in their skeletal system, exhibited only slight changes in the temporal bones, namely, slight apposition and slight circumscribed decomposition. The endochondral labyrinthine capsule remained free from changes. The animals of the third group, which on three succeeding days had been given 20, 40 and 60 units of parathyroid hormone and the skeletons of which showed increased osteoclasis on the inner surface of the cortex, showed only negligible changes in the temporal bones. In addition to mild processes of transformation, hardly exceeding the physiologic limits, in the periosteal labyrinthine capsule, there were no other changes. The endochondral labyrinthine capsule was again free from processes of transformation. The animals of the second group, which received a single dose of 40, 60 or 100 units of the parathyroid hormone and the skeletons of which showed osteoclasis on the inner surfaces of the walls of the bones showed increased transformation in the periosteal labyrinthine capsule, particularly at the border against the endochondral capsule. Even in the endochondral labyrinthine capsule, particularly in the region of the caudal and the horizontal semicircular canal, dilated vascular spaces existed, and they were under fresh resorption by large osteoclasts. The involvement of the endochondral capsule is especially noteworthy, for there was not only decomposition but also new formation of bone, a transformation not found in the other parts of the skeleton. In the first group of animals, which for a period of from seven to twenty-eight days had received daily 5 units of parathyroid hormone, the skeletal system showed no changes. The temporal bones were free from changes with the exception of the marrow spaces of the periosteal capsule, in which the endosteum showed considerable widening. After describing changes that he observed in the labyrinthine capsule of animals which had been treated for twenty-eight days with 1 unit of the hormone, Denker emphasizes that the prolonged administration of small doses of parathyroid hormone causes changes in the capsule of the semicircular canals which exceed those in the skeleton in general. The changes involve chiefly the endochondral capsule and the adjoining portion of the periosteal capsule. It is pointed out that generally the labyrinthine capsule is either not at all or only slightly involved in a systemic disease of the skeleton. For this reason the changes that take place in it under the influence of the administration of parathyroid hormone are the more surprising.

EDITOR'S ABSTRACT.

ROENTGENOLOGIC AND HISTOLOGIC STUDIES ON PETROSITIS. L. KRAUS, Ztschr. f. Laryng., Rhin., Otol. (Teil 1: Folia oto-laryng.). **26**:209, 1935.

Kraus discusses a group of inflammatory disturbances of the petrosal apex which are designated as petrositis or apicitis. He is chiefly concerned with the control of the roentgenograms by the histologic aspects and considers the clinical aspects only so far as they are necessary to clarify matters. The development of the petrositis is usually dependent on a pneumatized pyramidal apex; however, the pneumatization is not an absolute requirement, for it is known that, for instance, osteomyelitis of the apex usually develops in case of a spongious bone structure of the apex. Kraus says that in recent years he has observed a considerable number of patients with petrositis, the majority of whom were operated on and recovered. The true nature of the changes underlying the roentgenograms could be guessed at or could be partly explained by the surgical observations but could not be entirely verified except in the three cases which had a fatal outcome. In these cases it was possible to verify the roentgenologic aspects by the histologic observations. Since the literature contains as yet no report about the histologic control of the roentgenograms of the pyramidal apex involved in petrositis, Kraus describes these cases. All three patients had acute otitis, which took a rather protracted course. In all of them the otitis was caused by a mucosus organism, and mastoidectomy was done rather late. The symptoms that indicated severe

complications developed chiefly after the antrotomy. In two of the cases, the roentgenogram indicated clearly that a petrositis was the connecting link with the meningitis. In the first case, the interventions were indicated also by the clinical aspects, but in the last two cases the apical intervention was indicated by the roentgenogram. Kraus emphasizes that if in the postoperative period of acute otitis media meningitis develops which has not developed by way of the mastoid process or the labyrinth a Stenvers exposure should be made, for if petrositis exists this type of exposure may localize the process exactly. Depending on whether the defect is in the central, the upper or the lower portion of the petrosa, the exposure may eventually dictate the type of intervention. If the focus is in the upper part, the epitympanal antrotomy, Neumann's operation or Unterberger's operation is advisable. If the focus is in the basal portion, it is necessary to proceed according to O. Mayer, Ramadier or Eagleton. If the roentgenologic aspects correspond to the clinical ones, they may be judged positive; if they do not, caution is necessary in their interpretation. A negative roentgenogram in the face of positive clinical symptoms does not contraindicate surgical intervention. In the first case discussed in this report the histologic aspects corroborated the roentgenologic ones completely. In the second case the focus appeared larger in the roentgenogram than in the histologic picture, but the localization proved entirely correct. In the third case the localization and extension of the focus in the roentgenogram tallied completely with the histologic observations.

EDITOR'S ABSTRACT.

EFFECT OF QUININE ON THE ORGAN OF HEARING AND ON THE VESTIBULAR APPARATUS: A STUDY OF EXPERIMENTAL POSTURAL NYSTAGMUS. L. B. SEIFERTH, Ztschr. f. Hals-, Nasen- u. Ohrenh. **37**:367, 1935.

Seiferth points out that the disturbances which develop in the auditory organ as the result of the various toxic influences are designated as toxic neuritis acustica. However, this term covers various pathologic conditions. Studies revealed that degeneration of the auditory nerve is doubtful, but that changes occur in the cerebrospinal fluid which indicate involvement of the meninges in the toxic process. Moreover, it was found that the toxic disturbances in the apparatus of hearing and in that of equilibrium can be localized in the labyrinth as well as in the central tracts. The clinical examination frequently fails to reveal the localization. In order to throw more light on these problems, Seiferth resorted to experiments on animals. He wanted to determine whether following administration of toxic doses of medicaments the histologic examination reveals changes in the membranes of the internal ear and in the nerve trunk and its terminations. In dogs which had been given toxic doses of quinine by subcutaneous injection no petrosal histologic changes could be detected, either in those with acute or in those with chronic intoxication. Further, he tried to determine whether postural nystagmus develops in animals with intoxication, as a sign of impairment of the vestibular apparatus. He found that in rabbits with acute quinine intoxication it is possible to elicit nystagmus by postural changes. This postural nystagmus, although not a constant symptom, is nevertheless an almost regular symptom of acute quinine intoxication in rabbits. In the majority of the experiments the nystagmus proved to be mixed, with the vertical type predominating. The caloric and rotatory irritability proved to be normal during the quinine intoxication. Seiferth thinks that the site of elicitation of the quinine nystagmus is in the central nervous system, for the peripheral labyrinth was found intact during the intoxication and the other signs of intoxication were of central origin. He suggests that toxic doses of quinine probably cause changes in the endothelium of the small vessels, which in turn cause circulatory changes in the brain which, by influencing the central vestibular centers, produce a predisposition to nystagmus. The quinine influences the auditory organ and the apparatus of equilibrium in three directions: 1. By intoxication of the central nervous system it produces auditory disturbances. 2. It produces peripheral changes in the ear. 3. Quinine

idiosyncrasy results in disturbances of the cochlear and vestibular nerves. In the clinical manifestations of toxic neuritis acustica the inflammatory manifestations predominate. In nearly all cases the vascular connective tissue reacts to the toxins. Study of the cerebrospinal fluid obtained by lumbar puncture is helpful in the diagnosis of toxic neuritis acustica. If the fluid shows changes, lumbar puncture should be repeated for therapeutic reasons. EDITOR'S ABSTRACT.

OTITIS MEDIA IN NURSLINGS. A. TEN BOKKEL HUININK, Maandschr. v. kindergeneesk. **4**:219 (March) 1935.

Seven cases are described of children who were suffering from an alimentary intoxication which could not be ameliorated. In all cases purulent otitis was present, and in all instances in which the antrums were opened pus was found. Otologic examination did not give strong indication for antrotomy. Nevertheless, this procedure was performed in some cases and resulted in immediate recovery.

VAN CREVELD, Amsterdam, Netherlands. [AM. J. DIS. CHILD.]

## Pharynx

TRIPLEGIA FOLLOWING TONSILLECTOMY. A. BERNARD BRAHDY, Am. J. Dis. Child. **49**:716 (March) 1935.

In a boy aged 7 years, five days after tonsillectomy there developed in a rather short period flaccid paralysis of both lower extremities and of the right upper extremity. This was accompanied by complete loss of sensation to the level of the seventh thoracic segment on the left, with one segment of hyperesthesia on the left and involvement of all cervical segments on the right; there were also distention of the abdomen and incontinence of urine. Lumbar puncture revealed xanthochromic fluid, with 590 cells, which were mostly crenated red cells. Manometric tests gave normal results. Two weeks after admission to the hospital the patient had an attack during which he became lethargic and irrational; this was followed several hours later by edema of the face, legs and ankles. The patient vomited blood, and there was bright red blood in the stools and in the urine. Two days later the symptoms began to disappear, and at the time of discharge there was improvement in the condition of the right upper extremity. Three and one-half years later the patient had recovered use of the upper extremity but still had complete anesthesia and flaccid paralysis below the sixth thoracic segment. Brahdy believes that the condition was due to at least two emboli cutting off the blood supply of the spinal cord.

WAGGONER, Ann Arbor, Mich. [ARCH. NEUROL. & PSYCHIAT.]

TONSILLOGENIC MENINGITIS: DIAGNOSIS AND THERAPY BY ABSCESS TONSILLECTOMY. J. SCHUBEL, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **139**:389, 1935.

Schubel calls attention to a report by Wessely in which that author described the route by which the pathogenic micro-organisms from a paratonsillar abscess reach the meninges. This report and the realization that the diagnosis of a paratonsillar abscess may be extremely difficult induced him to describe a complicated case that was observed at his clinic: A girl aged 2 had coryza and earache with febrile temperatures. Two weeks later, abdominal pains developed. The practitioner who was consulted at this time diagnosed the condition as appendicitis and had the child transferred to the surgical clinic. Here the diagnosis could not be corroborated, and the child was sent to the children's clinic, where the abdominal pains disappeared and a catarrhal angina was detected. The tonsils were the size of hazelnuts and met medially. On account of the earaches the tympanic membranes were examined but proved to be free from irritation. When, after several days, the abdominal pains recurred, an appendectomy was performed,

but the appendix was free from changes. The postoperative course was uneventful except that the high fever persisted. It was then found that pus escaped from the right ear and that the palatine tonsils were greatly enlarged. An antrotomy was done, but it did not reveal the cause of the suppuration. A radical operation likewise did not clarify the problem. When the bandages were changed, however, pus was seen on the anterior wall of the auditory meatus, and then the perforation of a paratonsillar abscess was thought of. A tonsillectomy was performed, but the puncture of the paratonsillar tissues yielded no pus. An incision on the right side of the neck disclosed only a little pus in the parapharyngeal space, but the abscess membrane and the granulatioins could be recognized. At this time however, meningitic symptoms developed, and the child died. In discussing the case Schubel points out that all mistakes could have been avoided if, in view of the high fever, the earaches and the negative results of the otoscopic examination, paratonsillar suppuration had been thought of. He says that he has repeatedly recognized paratonsillar inflammation on the basis of this combination of symptoms. The early removal of the paratonsillar focus of infection would have prevented the endocranial perforation and the fatal outcome.

EDITOR'S ABSTRACT.

THE ORIGIN AND SIGNIFICANCE OF FUNGI IN THE CRYPTS OF THE TONSILS. G. SPONHOLZ, Frankfurt. Ztschr. f. Path. **46**:390, 1934.

The material on which this study is based was derived from 151 tonsils, 94 obtained surgically and 57 at autopsy. In 105 tonsils, fungi were present in about the same ratio in surgical and autopsy specimens. The fungi were found more commonly in hyperplastic tonsils from patients between 20 and 30 years old. Only very occasionally may fungi cause suppurative inflammation. However, they may lead to an accumulation of the material secreted by the neighboring salivary glands and possibly cause formation of sialoliths. The classification of the fungi meets with difficulty. They show some of the characteristics of Trichomycetes and some of Streptothrix.

OTTO SAPHIR. [ARCH. PATH.]

EFFECTS OF ACID AND ALKALINE DIETS ON TONSILS. H. HOEPKE and W. GRÜNING, Ztschr. f. Hals-, Nasen- u. Ohrenh. **37**:396, 1935.

Hoepke and Grüning made their studies on hedgehogs just after the animals awakened from five months of hibernation. The size and the histologic aspects of the tonsils during hibernation were known from former studies. It was found that an alkaline diet causes a considerable shrinkage of the tonsils (by about a third). The number of nodules is greatly reduced, and there are profuse formation and elimination of small lymphocytes. The lymph vessels that empty into the organism show profuse filling. After an acid diet, the tonsils decrease only slightly from their size during hibernation, and the number of nodules is slightly reduced. The formation of small lymphocytes is greatly inhibited and the formation of large cell forms increased. For this reason, the centers of the nodules are rather conspicuous. The discharge of small lymphocytes into the organism ceases or is only slight. In trying to explain this differing behavior, Hoepke and Grüning point out that the acid diet is nearer to the natural diet of the hedgehog than is the alkaline diet. In accordance with this, the reaction of the lymphatic system is less with the acid diet than with the alkaline diet. The latter elicits a spontaneous defense or a counter-attack in the lymphatic system.

EDITOR'S ABSTRACT.

## Larynx

TUBERCULOUS LARYNGITIS IN A CHILD. B. PINCHERLE, Pediatria **43**:576 (May) 1935.

A case of tuberculous laryngitis in a boy of 3½ years is reported, and a review of the literature is given. The patient exhibited extensive pulmonary exudative

lesions and a tuberculous lesion of the larynx of the ulcero-infiltrative type. Though the Pirquet and Mantoux reactions were negative, the tubercle bacillus was recovered from the mucosa of the larynx.

SIGNORELLI, New Orleans. [ARCH. PATH.]

THERAPY OF DISTURBANCES OF SPEECH AND VOICE. H. STERN, Monatschr. f. Ohrenh. **69**:813, 1935.

In the first part of his report Stern makes a few remarks regarding the treatment of lateral sigmatism. He points out that among the patients with this speech defect there are some in whom the proper position of the tongue and the proper direction of the air stream for the formation of the S sounds do not succeed in spite of all efforts. In such cases he urges the patient to bring his mouth into an exaggerated pipe position with indrawn buccal muscles. If this is done the patient quickly gets the feeling for the proper direction of the air stream; at the same time the center of the tongue forms a groove, and the lateral portion of the tongue, which was in the incorrect position, is brought away from that position and made to assume the right one. He points out further that the movements of the muscles of the face and mouth are usually more difficult and slower in persons who stutter than in normal persons. He says that rhythmic horizontal movements of the lower jaw during the process of phonation are well suited to improve this condition. This exercise, which he designates as *Kieferschütteln* (jaw shaking), although at first rather difficult for stuttering persons, produces a considerable improvement in their speech. Stern devotes the main portion of his report to the use of electric current in phoniatrics. He investigates whether and to what extent a better fixation of the larynx (with its favorable results) can be effected by treatment with electric current. In discussing the significance of the fixation of the larynx he stresses the importance of the hyoid bone and mentions the muscles that raise and those that depress the larynx. He shows that the depression of the larynx produces a number of favorable effects; it relieves tension, saves muscle powers, facilitates freer articulation, makes the vocal activity less labored and reduces the threshold of fatigue. He applies electrical stimulation to the muscles that depress the hyoid bone or the larynx, respectively, in order to effect fixation of the larynx in the optimal position and thereby exert a favorable effect on the voice production. After discussing the determination of the points of irritation on the muscles and nerves, the value of galvanic and of faradic current and the attachment of the electrodes, he points out that he combines electrical therapy with "internal singing," which involves a number of factors that aid and supplement one another in the depression of the larynx. He mentions (1) relieving the tension of the muscles that are active in raising the larynx, (2) keeping the larynx in the position of inspiration, (3) making adjusting movements before singing or speaking and (4) the so-called "covered mode" of singing. He asserts that in suitable cases this form of combination therapy produces improvement in or even cure of vocal disturbances. He shows further that the determination of the conduction resistance can be used for diagnostic and differential diagnostic purposes. Finally he discusses the use of iontophoresis in phoniatrics.

EDITOR'S ABSTRACT.

USE OF A TRACHEOSTOMA AS A VOICE-FORMING APPARATUS. H. STERN, Ztschr. f. Hals-, Nasen- u. Ohrenh. **37**:389, 1935.

Stern describes the history of a man aged 75 who five years earlier had undergone a laryngeal exenteration. Neither following the operation nor later had any vocal after-treatment taken place. The patient was in the habit of writing things down or employing the so-called mouth whisper. Stern had the idea of utilizing the tracheostoma as a voice-forming apparatus. First the patient was taught to blow against the skin folds of the tracheostoma. Then the physician brought the two skin folds together by means of his thumbs and had the patient blow against

the folds. At first there developed a friction sound, but after several days the patient was suddenly able to produce a clear and rather pure tone. Every day there was some improvement, and finally this manner of forming a voice succeeded even when the skin folds were not brought together but remained in their ordinary position. Further, the patient was taught to do the exercises which Stern employs in the treatment of defects of the recurrent nerve. They consist chiefly in rhythmic movements from the chin alternately toward the two clavicles. When these exercises were combined with the blowing against the skin folds of the tracheostoma the patient was soon able to vary the pitch of the sounds. The variation could be accomplished when the patient made a semicircular movement with his chin. After a few days the pitch could be varied even without these auxiliary movements, for the patient had learned to differentiate the sounds by changing the tension of the folds and by varying the force of the blowing against the folds. Stern describes the roentgenoscopic and the stroboscopic observations. Stroboscopy revealed that the skin folds of the tracheostoma describe rhythmic oscillations when the patient blows against them; that is, the skin folds of the tracheal opening are the source of the sound. If the patient uses his voice-producing apparatus and at the same time articulates the laws of acoustics require that the entire resonatory system shall cooperate. Stern thinks that this explains the good speaking voice of this patient, and he suggests that in similar cases the same procedure should be tried.

EDITOR'S ABSTRACT.

## Miscellaneous

MENINGEAL AND ENCEPHALIC REACTIONS IN OPERATIONS ON ENCEPHALITIC ABSCESSES. E. BOZZI, Arch. ital. di otol. **47**:679 (Oct.) 1935.

Bozzi made experiments in rabbits in order to clarify some of the points related to (1) the selection of the operation for a cerebral or a cerebellar abscess, which depends on the type of dural incision (small or large), and (2) the part that meningeal adhesions play in producing encephalitic reactions. He found that the application of iodine to the dura for forty-eight hours is harmless both to the meninges and to the encephalon and does not cause adhesions between the meningeal layers, though it causes slight meningeal reactions. He studied the several stages of the evolution of the operation performed according to Lemaitre's technic. Applying iodine to the dura before it is opened does not offer any advantages over the technic commonly used. When Lemaitre's technic is used a local meningitis the focus of which is in contact with the drainage tubes develops within six hours after the operation. Connective tissues begin to grow within twenty-four hours which within eight days form a complete tampon that prevents dissemination of the localized meningitis. Lemaitre's technic does not harm the encephalon. Experiments with a large meningeal incision gave poor results. Such experiments turned out better, however, when iodine was applied to the dura before the incision was made. Bozzi says that only the results in a large clinical series will solve the problem of selecting the operation. Lemaitre's technic seems to be indicated in a large number of cases, although in general an eclectic standing is advisable.

EDITOR'S ABSTRACT.

BLOOD TRANSFUSION IN THE TREATMENT OF OTOGENIC SEPTICEMIA. M. WEBER, Ztschr. f. Hals-, Nasen- u. Ohrenh. **37**:425, 1935.

Weber discusses the general aspects of the problem of blood transfusion in the treatment of otogenic septicemia and reports his own observations in fourteen cases. He emphasizes that in dealing with otogenic septicemia the first and most important measure is the removal of the infectious focus. Following the surgical removal of the focus an expectant attitude should be assumed, and only if the general condition is poor or if severe secondary anemia exists or the circulatory conditions are unfavorable should blood transfusion be resorted to. If the fever subsides after the operation, blood transfusion is not advisable, since it involves

the danger of an activation of the infection. Blood transfusion is too serious for one to employ it merely to improve the general condition or the status of the blood. If the fever persists after the first operation, one may conclude that a focus of infection exists somewhere, and that a revision of the wound or an after-operation is required. If the general condition is poor and there is fever, it is advisable to perform blood transfusion preparatory to the after-operation. Otherwise blood transfusion is indicated only if the revision of the wound or the after-operation is not followed by disappearance of the fever. If, in spite of thorough surgical intervention, the pyemic fever persists and the patient does not seem capable of coping with the infection, it is advisable to resort to blood transfusion in order to help the patient over the "dead point." Blood transfusion is sometimes helpful after all measures have failed, but it is not always effective. A repetition of blood transfusion is indicated if the first transfusion effected some improvement which, however, was followed by a renewed exacerbation of the general morbic condition. Then repeated small transfusions are often better than rarer transfusions of larger amounts. Blood transfusion is especially advisable if the otogenic general infection is complicated by erysipelas. However, in the presence of severe meningitis transfusion should be dispensed with because of the danger of cerebral edema. The efficacy of blood transfusion determines the prognosis of otogenic general infection. The prognosis is unfavorable if there is no or only brief improvement following the transfusion; it is favorable if there is definite improvement in the general condition. EDITOR'S ABSTRACT.

APPARATUS FOR ROENTGENOGRAPHY OF THE CRANIUM. H. LOSSEN, Ztschr. f. Hals-, Nasen- u. Ohrenh. **37**:459, 1935.

Lossen compares his own technic of roentgenography with that recommended by Mittermaier. He agrees that the method of Mittermaier has many advantages but shows that in some respects his own is superior to it. His apparatus is adjustable at different levels and thus permits the making of roentgenograms with the patient standing as well as with the patient reclining or sitting. He stresses that this is of especial advantage in hospitals in which many persons accidentally injured are treated. Moreover, his apparatus permits the fixation of the head for exposure in any direction. EDITOR'S ABSTRACT.

# Society Transactions

## CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

*Regular Monthly Meeting, March 2, 1936*

T. C. Galloway, M.D., *President*

Walter H. Theobald, *Secretary*

Bilateral Spastic Adductor or Flaccid Abductor Paralysis of the Larynx —Experimental Interpretation (*Besoin de respirer*). Dr. Louis Z. Fishman.

A systematic review of the greatest portion of the literature dealing with motor dysfunction of the larynx, particularly that portion which relates to the Semon-Rosenbach law, leads me to make a statement refuting the claims for the existence of such a simple law. In addition to this review, experiments are presented dealing with the effect of sinusoidal and faradic stimuli applied to the vagus and to the recurrent and the superior laryngeal nerves (internal and external branches) of the dog. These experiments indicate strongly that the positions of the vocal cords in cases of motor dysfunction of the larynx can be explained—certainly in a more complicated manner than by means of the Semon-Rosenbach law—by analyzing the basic anatomic and neurophysiologic principles which influence the pathologic occurrences.

Accordingly, I present a report on a patient who displayed evidence of a predominating psychoneurotic disposition and who, under the stress of a prolonged suspension laryngoscopy, displayed temporary glottic closure. The mechanisms which were involved in the production of the temporary fixation of the vocal cords in the midline are interpreted according to the principles which I have laid down and in such a manner as to expose the inherent complexities of this and similar cases. It follows that any analysis can but conform to an intricate pattern already alluded to. The following outline suggests the manner of approach which I chose to employ. Further, each separate factor of the following outline contradicts and tends to cast doubt on the plausibility of any simple rule, particularly Semon's, which may be advanced to guide the clinician in diagnosing derangements in the neurophysiology of an organ, in this case, the larynx, and prognosticating concerning them.

The different possible factors involved in this case were:

1. Physiologic fatigue of the abductors.

2. Autonomic nervous system in fatigue of the striated muscle.

3. Abductor psychasthenia or abductor neurosis.

4. Injury to the vagus (tenth) and to the eleventh cranial nerve or to its laryngeal branches.

5. Hyperphonasthesia or persistent reflex stimulation by instrumentation. The term "phonasthesia" is suggested as descriptive of the visceral proprioceptive sense (the latter a term advanced by Otto F. Kampmeier, professor of anatomy, University of Illinois), which is most probably recorded subconsciously in all during phonation. "Hyperphonasthesia, then, refers to an exaggeration of these afferent impulses. It is hypothecated that when the bulbar, thalamic and cortical centers for the larynx are subjected to an exaggeration of visceral proprioceptive impulses, glottic spasm follows.

6. Persistent stimulation by the local action of abnormally large amounts of inspired air, reflexly initiating glottic closure.

7. Persistent hyperpneic stimulation—the laryngeal test *besoin de respirer*.

I present next a case of organic (postthyroidectomy) motor dysfunction of the larynx in which the cords were fixed and taut almost in the midline. This case illustrates the influence which may be exerted on such an organic lesion by a state of mind called, for want of a better term, "psychoneurosis." For, by means of hypnosis (induced by Dr. Kraines, department of psychiatry, University of Illinois College of Medicine), sufficient relaxation of the muscles within and about the larynx was obtained to permit a greater amount of abduction than those muscles when spastic permitted, providing, thereby, enough airway to enable the patient to cork her tracheotomy tube. The same relief from acute laryngeal stenosis was also effected by injecting procaine hydrochloride (2 per cent solution) directly into the cricothyroid muscles transcervically and into the aryepiglottic muscles perorally. These experiments tend to show that a functional condition resulting in an increase in tonicity or spasm of the muscles of the larynx and pharynx—the motor nerve fibers to these muscles were presumably intact—was superimposed on and aggravated the already existing organic disturbance of the laryngeal neuromusculature. A most interesting observation, which has not been found reported in the literature, was made in this case: The attacks of urgent dyspnea to which the patient had been subject for four years were the result not of subglottic infection and edema but of the spasticity of the muscles encircling the supraglottic region of the larynx. It was observed that the muscles within the aryepiglottic folds and ventricular bands contracted and were then caused to relax in the manner of a membranous sphincter. While in a state of spasm or hypertonicity these sphincteric muscle bundles completely prevented any air from entering the larynx below.

Also, it was not found possible to effect contractions of the muscles of the larynx by applying electrodes to the outer surface of the neck. When electrodes were applied perorally to the larynx the sphincteric spasticities were enhanced.

In the course of experiments on dogs a nerve phenomenon was observed, an instance of which was later found recorded in the literature under the term *besoin de respirer*. In concluding, I quote from a report published by Hooper in 1886: "We wish to repeat that in our judgment the larynx is such a complicated organ; anatomically it is subjected to such changes at different stages of life, its shape is so different in different people, its nerve supply so great, the arrangement of its muscles so liable to anomalies, that as surely as one attempts to formulate theories on the positions above of paralyzed vocal bands—positions which may be controlled by intrinsic muscles of the larynx that are not paralyzed as well as those that are—just so surely will one be led unconsciously into erroneous mental inferences."

My conclusions are:

1. The case presented is either one of laryngismus stridulus (hyperphonasthesia) or one of abductor psychasthenia, and a diagnosis of flaccid abductor paralysis is as correct clinically and experimentally as the generally accepted one of spastic adductor paralysis.

2. There is no apparent proclivity of organic abductor paralyses or of functional adductor pareses; abductor psychasthenia predicates the not uncommon occurrence of functional abductor paralysis or, rather, abductor paresis.

Nor is there any difference in the vulnerabilities between abductor or adductor neurons or peripheral nerve fibers; differences depend, instead, on whether a lesion is irritative or degenerative. When unmyelinated, adductor nerve fibers are involved the laryngologist will have a cause for using the term "vulnerability."

3. A diagnosis of a lesion of a peripheral nerve as irritative or degenerative may point to a rational form of therapy and avert many contemplated surgical procedures on the larynx, procedures which are too frequently futile. Any procedure that is employed to correct motor dysfunctions of the larynx should be

aimed first at a physiologic restoration of function. Cordopexy, which offers mechanical restoration of laryngeal patency, should be performed only as a last resort.

4. The term "phonasthesia" is suggested as descriptive of the intrinsic sensibility of the larynx. Hyperphonasthesia is a definite, though for the present it is more or less a metaphysical, state of the larynx, which may easily simulate spastic adductor or flaccid abductor pareses.

5. Whether or not *besoin de respirer* or a modification of it is a valuable neurologic test under circumstances which permit direct exposure of nerves, such as might obtain during thyroidectomies, and whether or not the test is of sufficient value in other cases to warrant a surgical approach to the nerves of the larynx for a diagnosis depend on future reports of work continued along principles more or less similar to those outlined. Also, the thought is not amiss that some laryngologists might employ this test as the first step in performing a cordopexy. Should abduction of vocal cords which were previously fixed in the midline be obtained, the diagnosis of spastic paresis of adductors rather than that of flaccid paralysis of abductors would be established, the operation interrupted, and more rational methods of treatment entertained.

6. Electrotherapy for laryngeal motor disturbances is of no value in cases of spastic adductor or flaccid abductor paralysis, because, under the conditions, these muscles would be aided physiologically in their pathologic states. Experiments performed on patients form the basis for the statement that such therapy, as commonly employed, cannot accomplish even these harmful effects. In selected cases of flaccid paralysis, direct peroral faradization of the involved muscles by use of the induction coil or Sine machine may have beneficial effects. At least, such an attempt is rational.

FUNCTIONAL DISORDERS OF SPEECH AND THEIR CORRECTION. CLARENCE SIMON, Professor of Speech Reeducation, Northwestern University (by invitation).

Disorders of speech may be grouped conveniently under three heads: (1) faults in the production of tone, these faults being associated with the larynx and its attendant resonance cavities; (2) faults in the formation or modulation of tone into the articulate units of speech, referred to as difficulties of articulation, associated with the tongue, teeth, lips, jaws and soft palate and with their behavior; (3) intermittent disturbances in the rhythm of utterance, commonly known as stuttering. Any of these difficulties may involve either or both structural and functional disorders. The first two are clearly within the immediate interests of this group.

The voice itself, and by that I mean its quality or timbre, is a part of the general neuromuscular behavior of the organism. The muscles used in speech, particularly in the production of voice, are involved in every act of emotional expression. One is quite accustomed to seeing the scowl of anger, the heavy face of discouragement, the animation of friendship and love and the droop of defeat. The muscles controlling the larynx and the resonators respond to emotional states just as do the muscles of the face, with the exception that most persons control the facial muscles better than they do the laryngeal ones. In emotional states, there are profound changes not only of the skeletal tonus, the circulation, the respiration and the like but also of the tonus in the muscles of the voice. All persons tend to make habitual certain emotional adjustments to life and to the persons about them. And through this they make habitual certain types of vocal expression, certain usages of the vocal musculature.

These habitual usages may be within the strength of the musculature, or they may not. But few untrained voices are free from the damaging effects of their possessor's contact and conflict with present-day complicated environments. Vocal difficulties may be slight or great, static or progressive.

As emotional maladjustments become habitualized corresponding disturbances may result. These disturbances may be of the hypertonic or of the hypotonic

variety. Typical of the hypertonic variety is the harsh, rasping voice of the chronically irritated, habitually peevish person. When discussing this and other voices, I am not thinking of any esthetic objection to them but solely of the resultant discomfort to the patient and of the changes in structure which may result from their use. For prolonged hypertonic usage frequently produces conditions of strain and congestion which result in structural changes in the laryngeal mechanism. The high school or college student who in his habitual excitement and overstimulation puts a strain on his vocal mechanism in the regular routine of his recreation, and even more so at the school athletic contests, may lose control over his voice. In fact, the power to produce a voice may disappear completely either occasionally or permanently. The clergyman or other public speaker who consistently and habitually overloads his vocal mechanism finds himself in the same condition. But these are extremes. Identical results, however, are found in men and women whose emotional habits are such that they constantly produce their voices under hypertonic conditions. Persisted in, this hypertonic use of the voice, whatever its cause or source, will result in inflammation and irritation and ultimately in structural changes in the mechanism. An example of difficulty of this type is found in the laryngeal tension to which a patient is sometimes habituated following laryngitis, tonsillotomy or another profound disturbance in the vocal area. Certainly in some instances the changes in the quality of the voice reported following tonsillotomy are due to this perseveration of the habituation to tension.

The method of handling the patients with these conditions consists essentially in setting up good habits of relaxation—both generally throughout the body and specifically in the laryngeal areas. They must also be given a certain amount of adjustment to their environment, an insight into the causes of their condition and opportunity to form new habits. In the absence of this functional treatment, this formation of new habits of living and of speaking, other methods of handling can give but temporary relief—for the underlying conditions have not been changed.

A quite opposite vocal difficulty is found in the hypotonic person. This person is the whiner, the one who feels defeated by life or for whom life is too much. The characteristic picture is of too great relaxation of the entire musculature including that of the vocal area. The weakness of voice, the lack of energy and vitality, can be handled best by a stimulation of the entire person to a more active, aggressive and competent adjustment to the job of living.

The essential point of consideration is that these bad usages, made habitual and persisted in over long periods of time, gradually alter structure and bring on conditions that can be described only in terms of pathology, and that in the absence of functional treatment other forms of relief are temporary.

Many difficulties of articulation are functional; that is, they are the result of early habits which have persevered. One is familiar with the person who has come to adulthood with certain typical infantile sounds in his speech because his parents thought that "baby talk" was cute. Also one is familiar with the person in whom an early loss of the deciduous teeth has set up bad habits of the tongue or lips in speech. Similarly, bad usage which originated in structural anomalies persists even after structural repair. If the cleft palate, for instance, is not repaired early enough, the child will continue to talk with a cleft-palate voice and speech, even though structurally his apparatus may be perfect. Similarly, following dental adjustment by the orthodontist the speech difficulty tends to persist unless there is specific retraining of the mechanism involved. Operation, adjustment, structural repairs and physical therapy do not penetrate to the centers of habit. These can be reached only through showing the specific correct sound position, training the patient's ear to distinguish between his incorrect sound and the correct standard of pronunciation and leading him, through continuous practice, to produce the selected sound correctly both as an isolated unit and as it occurs in a total configuration of words and sentences.

Speech represents a hierarchy of complicated skills and habits. It depends on a structure that is sound, healthy and normally built. Equally it depends on a group of coordinated habits, which involve not only the act of speaking but the acts of adjustment to the environment and to living. If there are deviations in

either the structural or the functional aspects, speech difficulties result. And the proper management of speech difficulties depends on both a structural and a functional approach, with a balance to be determined by the actual conditions of the case. It is extremely doubtful whether any handling of the speech difficulty will achieve permanent and lasting improvement if the functional aspects are not given due consideration.

### DISCUSSION ON PAPERS READ BY DR. FISHMAN AND DR. SIMON

Dr. A. A. Low: Dr. Fishman, if I understood him correctly, meant to demonstrate by means of two observed clinical cases and by means of experimental work that a certain adductor spasm is essentially due to an abductor weakness. He then postulated that this abductor weakness is functional. It is, of course, important to have experimental work done with a view to differentiating between functional and organic conditions, so I shall not discuss the merits of these experiments. Nor shall I discuss matters of experimental technic beyond stating that the essayist made a creditable effort to obtain an optimum of control situations.

I should like to know what Dr. Fishman means by the term "functional." The term has two main connotations: If a trigeminal neuralgia is said to be functional, the term implies merely that an anatomic change is not present or is not recognized; in this sense "functional" means that the condition is physiologic rather than anatomic. If Dr. Fishman interprets the term in this manner, I think the existence of the condition described is capable of experimental proof or refutation. But there is another interpretation of the term. I shall give an illustration. A patient has a habit of vomiting but vomits on Sundays or holidays only, never on week days. A condition of this kind is also functional, but there is a difference between "functional" as applied to the trigeminal neuralgia and "functional" as applied to the condition of holiday and Sunday vomiting. It is inconceivable that an anatomic or a physiologic entity should differentiate between holidays and work days. Obviously it is the patient who makes the distinction, not the anatomy or the physiology of the patient. In other words, in this case the vomiting is produced by an idea. For instance, by the idea that holidays make a psychoneurotic person cease working and start thinking and worrying. Psychoneurotic persons may dislike holidays and express their dislike by means of vomiting. I do not think Dr. Fishman had this definition of the term "functional" in mind when he devised his experiments. However, I read his notes and I saw the term "abductor psychasthenia," and that term suggests, perhaps wrongly, that the term "functional" was employed in the sense of "psychogenically determined." If this is so I do not see how the statement that the abductor weakness is psychogenic can be verified or disproved by experimentation. I know of only one type of experimentation that can prove whether a condition is psychogenic or physiogenic, and that is hypnosis. If the patient with the holiday vomiting is given, under hypnosis, the posthypnotic order to produce vomiting on a plain Tuesday morning, when there is no holiday, and he produces it, and if then, by further suitable experimental arrangement, I manage to control the vomiting at will, I have shown by experimentation that the vomiting is due to a psychic element—to my posthypnotic order.

I think Dr. Fishman did not use the term "functional" in the sense of "psychogenic." What he had in mind was obviously "functional" in the sense of "physiologic—not anatomic." In this restricted meaning the term lends itself to experimentation, and I congratulate Dr. Fishman on his courage in entering on experimentation in such a difficult field.

Dr. Simon essentially gave a synopsis of the diagnosis of speech disorders and outlined one of the methods in dealing with such disorders. I am certain that Dr. Simon knows other methods of approach. The one he uses is as good as any other, and probably he has good reasons for following it. He did not mention the psychotherapeutic approach. In viewing the problem of speech correction one is well aware of the therapeutic split that runs through the entire field of functional disorders. On the one side are physicians who claim that everything functional must be treated psychotherapeutically; on the other side are those who

claim that every patient must be treated by methods of physical training. As always, the truth is midway between the extremes. The physician who limits himself to vocal, breathing and other physical exercises attacks the problem at the periphery. The one who makes the other approach neglects the periphery and goes to the center, the cortex, and treats everything psychotherapeutically. I am a neuropsychiatrist and therefore also a psychotherapist. However, I never treat a rhinolalia with psychotherapy nor do I ever subject a stammerer from stage fright to vocal exercises. The rhinolalia calls for the peripheral approach; the stage fright, for the central approach.

Dr. Elmer L. Kenyon: I shall present and discuss a case of hoarse voice produced by approximation of the ventricular bands which was dependent on functional aphonia. (The report will appear in connection with an article soon to be published by Dr. Kenyon.)

Dr. Samuel H. Kraines: In the case cited by Dr. Fishman, hypnosis was used in an effort to relieve the functional spasm of the false cords which accompanied the paralysis due to the nerve lesion. The case exemplifies well the fact that many organic conditions are accompanied by functional symptoms. Treatment, as a rule, must be directed not only to the organic disease but also to the emotional difficulties that coexist. In a patient suffering from epilepsy, for example, in which there is actual damage to the brain, the number of spells is decreased when the patient is taught to look at his illness more objectively and less emotionally.

The patient presented by Dr. Kenyon was in my clinic at the dispensary of the University of Illinois. He complained of difficulty in vision, pains in his shoulder, colic in the abdomen, a sore throat and inability to speak above a whisper. Several medical departments had refused to treat him because of the obvious neurotic nature of many of his complaints. He refused treatment in the department with which I am associated and, even while under Dr. Kenyon's care, went to several other clinics. The successful results obtained are due not to the speech training but to the change in the neurotic state of the patient. I just finished speaking with him. Whereas formerly he had been depressed and seemingly hopelessly dominated by his father, his present attitude is entirely different. "I'm no longer going to live the way I used to. I've made up my mind that I've got my own life to lead. In spite of what my father says, I'm going to go to school, and going to get a job, and am going to get ahead. No more sitting around in my father's shop all day long and listening to him bawl me out." The patient has changed his entire attitude toward life, and not only has the aphonia cleared up, but the other neurotic traits also have disappeared. The speech training was only an incidental aid. The treatment of aphonia may therefore be summed up as follows: Remove the cause by (1) determining and removing the organic factors involved, (2) determining the basic emotional forces that brought on the neuroticism and adjusting the patient to these forces and (3) dealing with the organ affected—in this case, by speech training. Such treatment will not only clear up the functional derangement of the organ involved but leave the patient better adjusted to life.

Dr. Francis L. Lederer: It is most unfortunate that the case reported by Dr. Kenyon should be introduced here this evening, for it detracts from the importance of the two prior excellent presentations. Nevertheless, the case is of interest because it illustrates what harm may come from improper and ill directed treatment. This patient was not sick until he consulted a doctor. I believe that all of the procedures, including the submucous resection, the bronchoscopies and everything else, instead of acting in a helpful or a suggestive manner, merely added to the mental and physical trauma. Often in cases of this kind great mistakes are made, one outpatient department being just as much to blame as another in overtreating the patients. As to describing the typical picture presented by this boy, it is an impossible task; each week of observation he presented a different laryngologic picture; this no doubt accounts for the variability brought out in Dr. Kenyon's recital of the history of this case. The patient's voice was not always aphonic when I observed him. The condition started with a functional paresis of the

transversus linguae, and then changes developed that could be ascribed to secondary laryngitis. No doubt in this boy one is concerned with a psychiatric problem rather than an organic disturbance.

I wish to express my appreciation to Dr. Simon for making speech defects a rather interesting subject. I think laryngologists have steered clear of speech defects because the treatment of them is so time-taking and tedious. I hope that some day my colleagues and I will have a speech department in addition to our psychiatric department. It must not be lost sight of that while Dr. Simon has brought out one phase of the speech problem there are other factors which deserve the interest of the psychiatrist and the laryngologist.

Dr. Louis Z. Fishman: I wish to thank Dr. Low for his constructive discussion of a subject which, because of its very nature, leads one into a maze of controversial ideas. However, I think that Dr. Low has somewhat misunderstood my paper so far as concerns the emphasis given to functional considerations. Although the factor of abductor psychasthenia in the first case opens the way for a discussion of the implied functional, or metaphysical, state, it was included merely in transition to the interpretation of the case by more factual data and by the results of my experiments. On the other hand, I might add that my greatest difficulty was experienced whenever a physiologist came on this particular part of the paper, as physiologists do not entertain the existence of functional disorders, saying that if the microscope could be focused on all living cells physiologists would soon discover the particular organic derangement or pathophysiologic process responsible for what I have called functional disorders.

Regarding Dr. Kenyon's patient, whom I saw last week again, there were still definite signs of a paretic state of the vocal cords, yet he has a good voice. Also, there was an infiltrative process in the interarytenoid sulcus. I cannot understand, then, Dr. Shambaugh's negative laryngoscopic findings.

Regarding Dr. Kenyon's phrase "amnesia to use loud voice," with which he interprets this patient's aphonia, I should like to call attention again to the term "phonasthesia," which, if changed to indicate a lack of phonasthesia, i. e., to "hypophonasthesia," may be made to mean the same as Dr. Kenyon's apt description. It may be added that Dr. Simon's work and Dr. Kenyon's work in certain cases consist in an attempt to obtain a state of phonasthesia, or a normal phonatory mechanism.

Referring to Dr. Jackson's article with which Dr. Kenyon has found fault, my colleagues and I also have felt that his operation on spastic or compensating false cords is a questionable procedure. I should like to point out that although Dr. Jackson has recommended surgical correction of the false cords in his article I have failed to find at any place in this article mention of a case in which he performed such a procedure.

Dr. Clarence Simon: I am glad Dr. Kenyon mentioned the matter of the whispered voice, for it has been my observation that in irritation of the larynx or strain of the larynx the whisper frequently is much more damaging than mild phonation. My associates and I have recommended silence but have found that some of the patients still had a progressive condition. They said they were not talking but were whispering. That apparently did more damage than using the voice.

I have been much interested in this discussion because I am unable to get away from the idea that speech, being the last acquired item of human behavior, is probably the least stable and the most disarranged by any difficulty that may arise. I am sure that whenever one confronts a speech problem or a speech deviation of any kind, the first step should be to rule out the possible factors, one at a time, and find out where the difficulty is located.

My only desire in discussing this subject is to throw out before this group the concept that there are speech and voice difficulties which are due solely to the fact that the sufferers are doing a rather unskilful job of living. Whether this group calls that a psychiatric problem, a physiologic problem or some other problem, I shall not quarrel with it. My only desire is that the patient shall have the benefit of all phases of treatment.

# Book Reviews

**Diseases of the Nose, Throat and Ear for Practitioners and Students.** Edited by A. Logan Turner, M.D., LL.D., F.R.C.S.E., Edinburgh. With the collaboration of J. S. Fraser, M.B.; Douglas Gutrie, M.D.; Charles E. Scott, M.B.; J. D. Lithgow, M.B.; G. Ewart Martin, M.B., and John P. Stewart, M.D. Fourth edition, fully revised and enlarged. Price, $6. Pp. 494, with 243 illustrations and 21 plates, 8 in color. Baltimore: William Wood & Company, 1936.

This is the fourth edition of this outstanding textbook in English on the nose, throat and ear. Each section has been carefully revised, and new illustrations have been added. The subject of nasal polypi is discussed in a separate chapter, as are also allergy and allied conditions. In order to keep the text abreast of the times certain subjects appearing in previous editions have been deleted. Sluder's intranasal operation for polypi and dacryocystostomy fall in this category. The present volume contains a short account of nodes of the vocal cords of singers.

Previous editions of this book have been reviewed in the ARCHIVES as follows: first edition, **1**:129 (Jan.) 1925; second edition, **7**:196 (Feb.) 1928; third edition, **17**:287 (Feb.) 1933.

# Directory of Otolaryngologic Societies *

## FOREIGN

### Collegium Oto-Rhino-Laryngologicum Amicitiæ Sacrum

President: Prof. Gunnar Holmgren, Karolinska Mediko Kirurgiska Institut, Stockholm, Sweden.
Secretary: Prof. Dr. C. E. Benjamins, Verlengde Heereweg, 143 Groningen, The Netherlands.

## NATIONAL

### American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Robert F. Ridpath, 1737 Chestnut St., Philadelphia.
Secretary: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Place: Atlantic City, N. J.

### American Academy of Ophthalmology and Otolaryngology

President: Dr. Wells P. Eagleton, 15 Lombardy St., Newark, N. J.
President-Elect: Dr. Frank E. Burch, 408 Peter St., St. Paul.
Executive Secretary: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: New York. Time: Sept. 26-Oct. 3, 1936.

### American Bronchoscopic Society

President: Dr. H. M. Taylor, 111 W. Adams St., Jacksonville, Florida.
Secretary: Dr. Lyman Richards, 319 Longwood Ave., Boston.

### American Laryngological Association

President: Dr. Burt R. Shurly, 62 W. Adams Ave., Detroit.
Secretary: Dr. James A. Babbitt, 1912 Spruce St., Philadelphia.

### American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. George M. Coates, 1721 Pine St., Philadelphia.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester, N. Y.

*SECTIONS:*

Eastern.—Chairman: Dr. D. C. Jarvis, Quarry Bank Bldg., Barre, Vt.
Southern.—Chairman: Dr. Charles D. Blassingame, P. & S. Bldg., Memphis, Tenn.
Middle.—Chairman: Dr. Alfred Lewy, 25 E. Washington St., Chicago.
Mid-Western: Dr. Frederick A. Figi, 1013 First St., S.W., Rochester, Minn.
Western.—Chairman: Dr. David R. Higbee, 3245 Fourth St., San Diego, Calif.

### American Otological Society

President: Dr. Francis R. Packard, 304 S. 19th St., Philadelphia.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.